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VOL. XLVII.

"There is no art or science that is too difficult for industry to attain to; it is the gift of tongues, and makes a man understood and valued in all countries, and by all nations; it is the philosopher's stone that turns all metals and even stones into gold, and suffers not want to break into its dwelling; it is the north-west passage, that brings the merchants as soon to him as he can desire—in a word, it conquers all enemies, and makes fortune itself contribution."—LORD CLARENDON.

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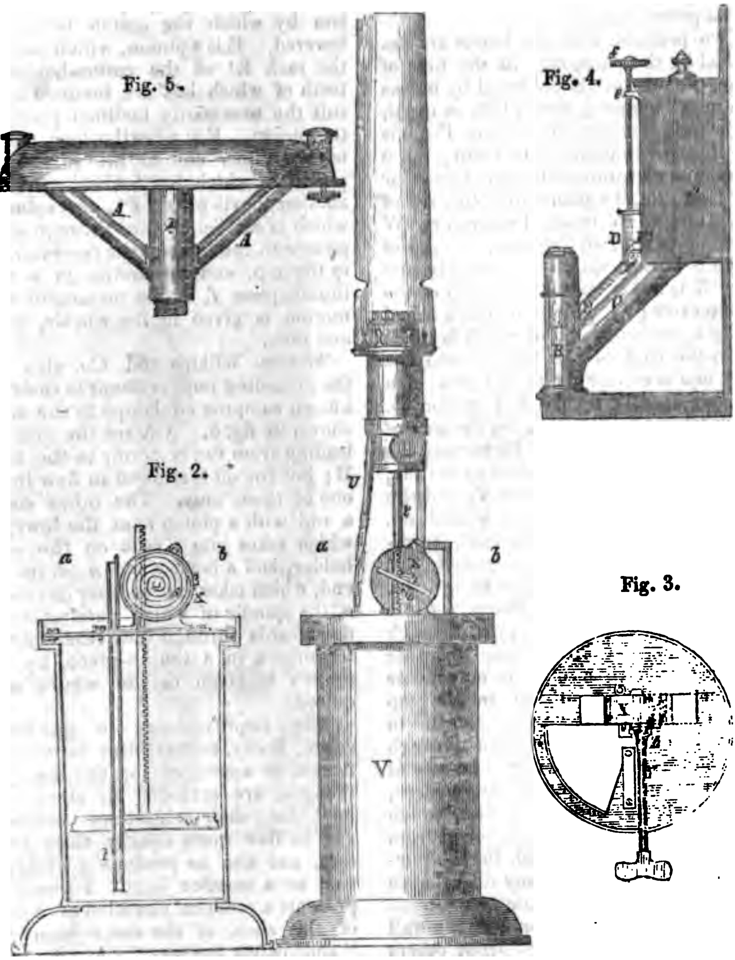
MESSRS. WILKINS AND CO.'S SPRING PRESSURE FOUNTAIN LAMPS AND DIAGONAL GAS BURNERS.

Fig. 1.



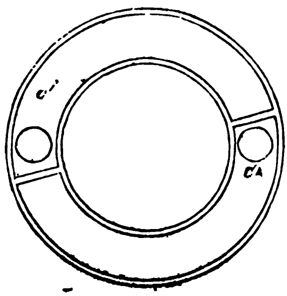


Fig. 7^a.

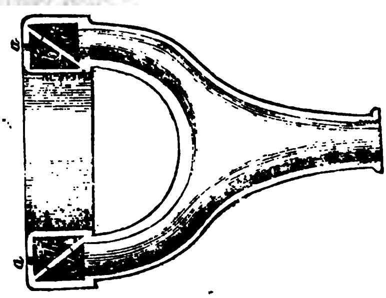


Fig. 7.

MESSRS. WILKINS AND CO.'S SPRING PRESSURE FOUNTAIN LAMPS AND DIAGO

GAS-BURNERS.

AMONGST the latest novelties in lighting (with oil and gas), the articles which form the subject of our present article hold a prominent place.

Two pressure fountain lamps are described by the patentee. In the first of these, the pressure is produced by means of a metallic spring, instead of, as usual, by the weight of the atmosphere. Fig. 1 is an external elevation of this lamp; fig. 2 a sectional elevation of the parts peculiar to it; and fig. 3 a plan on the line *a b* of figs. 1 and 2. V is an oil reservoir; W a leather piston, or plunger, the rod of which is formed with a rack on one side of it; X is a box bolted to the top of the oil-reservoir (V), which contains a coiled spring *s*, the outer end of which is made fast to the case of the box X, and the inner end is connected to the end of a spindle Y, which carries a pinion Z, which takes into the rack on the side of the rod of the piston W. By turning the pinion Z, the piston is raised to the top, or nearly so, of the reservoir V, and the spring *s* at the same time wound up. And as the spring unwinds itself, it gradually forces the rack, piston-rod, and piston downwards, which, in their turn, force up the oil through the pipe *t* into the burner. U is a waste-pipe, through which any excess of oil is returned from the burner to the reservoir. It may either terminate over an orifice in the top plate of the reservoir, as shown in figure 1, or be carried down through that plate into the reservoir. In case of the spring being ruptured by accident, or otherwise damaged, the box, which contains it, can be readily unbolted from the reservoir, and removed, for the purpose of repair, without any disturbance to the other parts of the lamp.

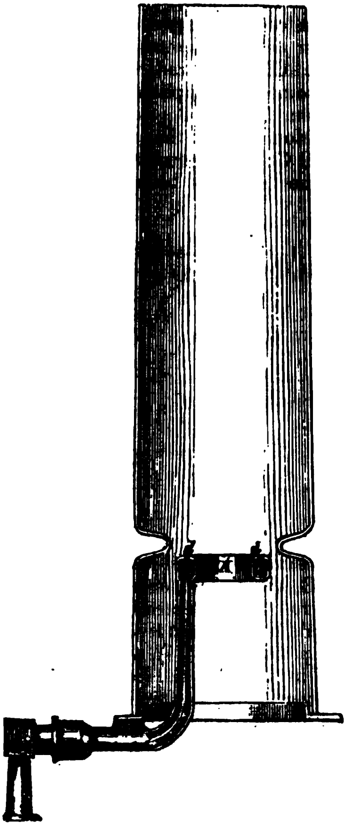
The other fountain lamp is of the wall class, and is distinguished from others in having an arrangement by which the cotton may be raised or lowered without the aid of a stuffing-box, and the possibility of leakage is thereby wholly prevented. A side elevation of a lamp of this kind, as thus improved, is given in fig. 4. A is the fountain or reservoir, which communicates by a pipe C with the burner B. D is a pipe, which is fixed in front of the fountain, and may either extend the whole way up, or only as far as represented in the drawing, and leads off at bottom to the burner at the same angle with and immediately of the oil-pipe C. In this pipe a closed the principal parts of the me ism by which the cotton is rai lowered. E is a pinion, which tak the rack E^1 of the cotton-holde teeth of which last are inclined s suit the necessarily inclined posit the pinion. F is a bevil-wheel, at to the upper end of the shaft pinion E, which bevil-wheel work another bevil-wheel F^1, the spin which is carried upward through a piece *e* in the front of the reservoir to the top, and terminates in a thumb-piece *f*, by the turning of motion is given to the wheels, p and rack.

Messrs. Wilkins and Co. also the preceding improvement to their known catoptric oil lamps in the m shown in fig. 5. A A are the side leading from the reservoir to the b B; but the oil is allowed to flow th one of them only. The other co a rod with a pinion *m* at the lowe which takes into a rack on the c holder, and a bevil-wheel *n* on its end, which takes into another bevil- *o*, the spindle of which passing st downwards through the reservoi terminates in a thumb-piece, by motion is given to the whole quired.

The improvements in gas-b relate, firstly, to that class in whi flames, or apertures for the esca the gas, are arranged in circles have for their object to caus gas to flow more equally than h fore, and also to produce a clea well as a steadier light. Figure presents a sectional elevation of a l of this class, of the description "shadowless burners." A is an burner, and *b* a perforated plate in crosswise in the interior of it. E the holes in the burner is form the junction of two holes drilled inclined direction, the one to the as commonly done in the boring fish-tail burner. The perforated serves to check the flow of the ga the inclined passages to divide t into as many double streams c each other at the point of ignit there are orifices *d d* on the top of the burner, whereby a much

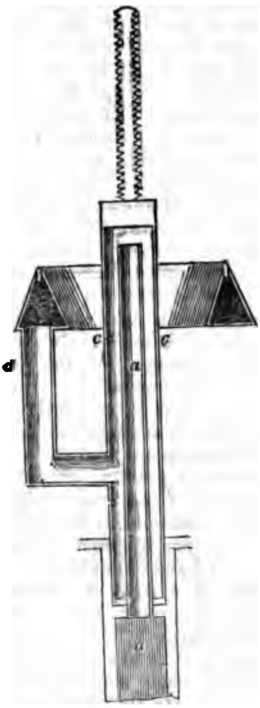
ombustion of the gas is effected than ould otherwise take place.

Fig. 6.



A second improvement in gas burrs consists in the following new arrgements, for heating the gas before ching the point of ignition. Figures and 7ª represent a form of burner structed with this view: The gas made to traverse in the burner through rly one half of the whole circuit its circumference before it is allowed to escape through the holes from which it is consumed, by which means the gas is partially heated before reaching the point of ignition; *a a* are the perforations for the escape of the

Fig. 8.



gas; b^1 b^2 the channels through which it flows to them; and c^1 c^2 are two auxiliary passages in which the gas is heated before entering into the channels b^1 b^2. Fig. 8 represents another mode of effecting the heating of the gas previous to combustion: *a* is the pipe through which the gas is admitted, and by which it is carried up nearer to the button or deflecting disc; it then descends inside another pipe *c*, surrounding the pipe *a*, and absorbs in its passage a considerable portion of heat from the heated surfaces of *a* and *c*; *d* is a third pipe which conveys the gas to the burner.

REMARKS ON THE USE OF MATHEMATICAL KNOWLEDGE TO ENGINEERS, AND H THOSE WHO HAVE NOT THE BENEFIT OF A TUTOR.

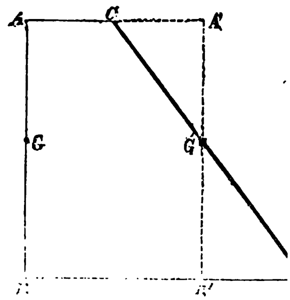
(Continued from p. 621, vol. xlvi.)

In the locomotive the only external force (besides the resistance of the air) is the friction which enables the wheel to lay hold of the rail, and by an action precisely the same as that of a cog-wheel and rack (only that the teeth of the wheel and rail are invisible from their minuteness), sends the engine on, because the rail is fixed (if the engine were fixed and the rail movable, it would be the rail that would be sent backwards, just in the same way as the engine is now sent forwards). The centre of gravity of the engine will therefore move in the same way as if this force were immediately applied to it. The motion of the various parts of the engine *amongst each other* can in no way affect the motion of the centre of gravity; they are of course necessary in order to produce the revolution of the wheels, and by their friction against the rails to obtain the *external* force; but of themselves they are entirely without influence on the progressive motion of the engine.

The fact that it is utterly impossible for any motion amongst the various parts of any machine to produce a motion of the centre of gravity—except in so far as this internal movement calls into play some force *external* to the machine—has been forgotten by many projectors, although all have not exhibited it in quite so barefaced a light as the worthy who proposed to propel a boat by simply erecting a large bellows near the stern, and blazing away at a board placed there. If he had been content with puffing away at "empty air," he would have got on better; for he would then have called into play an external force, namely the resistance, such as it is, of the particles of air to the impinging current from his bellows—and the re-action would have all been available, just as in the rocket.

This principle of the independence of the motions of rotation and translation being, as I have said, one of the most important and useful in mechanics, it is worth while to consider all the circumstances connected with it:

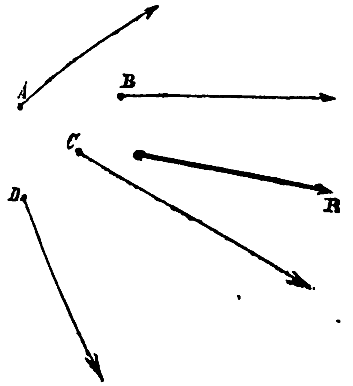
And, in the first place, since the effect of any force P on the motion of rotation depends on the distance of its point of application from the centre of gravity, whilst its effect on the motion of the centre of gravity is the same at w point of the body P be app would appear at first sight that th *gain of force*, or a general incr effect produced according as the p P's application is further remov the centre of gravity. But the co ation of one simple case will su show the erroneousness of this. pose AB to be a rod, which by th of some force applied to it at a p tween G and B, transfers it i position C D; the angle D G A′ G C, will be greater the furth G the force has been applied.



the same force had been applied at G, the middle, or centre of gra the rod, and had acted for the same would have carried it parallel to its the position A′B′. If, therefore, we the measure of the force the qua matter moved, multiplied by the v with which it is moved (or, which same thing, by the space over w is moved in a given time), we s the effects of the force, measured way, are the same, whether it ha applied at G or at any other poin much as they are represented equal areas A C B D, A A′B B′.

The following is another met considering the principle:

Suppose any number of bod points, A, B, C, D, &c., perfectly nected with each other and free t any how, are moving along certai directions, as in the figure, with a locities; since each body move constant direction during the time considering, the direction of th



acting upon it remains the same during this time, and may also be considered *uniform* during this time (for as the time during which the forces act does not at all affect our present question, we may take it as small as we please, and apply the reasoning of the differential calculus). Therefore the general resultant of all the forces will maintain a constant direction and magnitude during the time, as also will the resultant moment or "couple" (these two quantities being determined as if A B C D, &c., constituted a solid system). Now suppose all these separate bodies A, B, C, D, &c., to become suddenly connected together, so as now to form one rigid system. The motion of each individual body or particle will now be altered, in consequence of its connection with the rest; and in order to determine the subsequent motion of each we must take into account all the fresh forces thus introduced. For instance, if A become connected with B by a rigid rod, at the instant of connection, there arises a tension, or pressure, in this rod. Call it T; then, in addition to the force (P) which before acted on A, we must consider T; and so on for every other point. But T acts on B as well as on A, only in the opposite direction. Hence, in forming the general resultant of all these *new* forces, for every term (+T) there will be another (-T), so that the resultant of all this newly introduced force, as well as their resultant couple, or moment, is reduced to zero. Therefore the resultant of *all* the forces, originally acting and newly introduced, remains the same as before. If the direction of the resultant were that represented in direction and magnitude by the line R in the figure, *before* the connection, it will also be their resultant *after* that connection. Provided, therefore, the *external* forces acting on any system of particles or bodies, remain the same, the motion of the centre of gravity, and the rotation round that centre, will remain unaltered, whatever be the action of any one part of the system on another by means of any *mutual* forces, such as that of rods, &c. The preceding is similar to Poinsot's mode of considering the question in his *Memoire sur la Composition des Mouvements, &c.;* but he supposes the *velocities* of each of the points A, B, C, &c., before connection, to be *uniform*, and says, that therefore the "force which animates it remains constant:" it is better, however, I think, to consider the forces *acting* on A, &c., rather than the momenta *animating* them —and if the velocity be uniform, the force *acting* is zero. The theorems called "The Conservation of the Motion of the Centre of Gravity," and "The Conservation of Areas," are merely the expression of the results just obtained in an analytical form adapted to calculation—or, rather, I should say, the latter of these theorems is such.

There is another theorem of great practical use, which has received the name of the "*Principle* of Vis Viva," which differs however from the preceding principle, inasmuch as it is merely *a very useful equation or relation* amongst the various effects of the forces; whereas the other is a general principle, strictly so called: both, however, are of the greatest use in simplifying problems.

As this principle or equation of Vis Viva is of great importance in a practical point of view in the calculation of the "work done" by machines, I shall take up the subject from the beginning, assuming only the equations of motion. In most works, the investigation is founded on the principle of virtual velocities, which I consider to be very objectionable, as no proof of that principle has ever yet been given in which everybody agrees; and, at any rate, not one student in a thousand ever reads such proofs as have been given. As, moreover, there is not the slightest necessity or reason for any reference whatever to that principle, I think it far better to treat the subject independently. Suppose, then, m, m', m'',

&c., to be a system of particles anyhow connected, and acted on by external as well as by mutual forces. Let *all* the forces acting on (m) be equivalent to X, Y, Z acting along the co-ordinate axes. These forces, it must be r lected, are supposed to include the sions, mutual pressures, and, in all the mutual actions of the other cles, as well as the given external c

$$\therefore \frac{d^2x}{dt^2} = X \quad \frac{d^2y}{dt^2} = Y \quad \frac{d^2z}{dt^2} = Z.$$

$$\therefore 2\frac{dx}{dt}\cdot\frac{d^2x}{dt^2} + 2\frac{dy}{dt}\cdot\frac{d^2y}{dt^2} + 2\frac{dz}{dt}\cdot\frac{d^2z}{dt^2}$$

$$= 2.\, X.\frac{dx}{dt} + 2.\, Y.\frac{dy}{dt} + 2\, Z.\frac{dz}{dt}.$$

$$\therefore \left(\frac{dx}{dt}\right)^2 + \left(\frac{dy}{dt}\right)^2 + \left(\frac{dz}{dt}\right)^2 \text{ or } V^2 = 2\int\left(X.\frac{dx}{dt} + Y.\frac{dy}{dt} + Z.\frac{dz}{dt}\right) d$$

$$= 2\int\left(X\, dx + Y\, dy + Z\, dz\right)$$

$$\text{or } mv^2 = 2m.\int\left(X\, dx + Y\, dy + Z\, dz\right).$$

Similarly, if X′, Y′, Z′, represent the *whole* of the accelerating forces acting on then for its velocity (v') we should have

$$m'\, v'^2 = 2m'\int\left(X'\, dx' + Y'\, dy' + Z'\, dz'\right),$$

and so on for all the particles. But it is obvious, that in these equations, as they stand, we have, or may have, a number of *unknown* forces, inasmuch as X, Y, Z and X′, Y′, Z′ include the internal actions, of which we know nothing except that they are *mutual*. Fortunately this knowledge that they *are* "mutual" is enough to enable us to get rid of them: otherwise these equations first found would be of no earthly use. Sup therefore, that in addition to the ex forces— all of which are known— is included the tension or mutual pre of a rigid rod connecting (m) and Denote this pressure by P. Let th or line mm' make angles α, β, γ wi axes. Then, amongst the accele forces acting on (m), we have

$\frac{P}{m}\cos\alpha$ acting along axis of x and $\therefore$ included in the X,

$\frac{P}{m}\cos\beta$ ditto y and $\therefore$ . . . . . Y,

$\frac{P}{m}\cos\gamma$ ditto z and $\therefore$ . . . . . Z.

But the *pressure* on the other particle (m') exerted along mm' is equal to th (m otherwise acts in exactly the opposite direction. So that if one be considered pos the will be negative. Hence, amongst the forces X′, Y′, Z′ acting on there will be

$-\frac{P}{m'}\cos\alpha$ acting along axis of x, and $\therefore$ included in the X′,

$-\frac{P}{m'}\cos\beta$ . . . . y, and $\therefore$ . . . . Y,

$-\frac{P}{m'}\cos\gamma$ . . . . z, and $\therefore$ . . . . Z′.

Therefore in forming the sum of mv^2 and $m'v'^2$ on one side of the equation, the o namely,

$$2\, m\int\left(X\, dx + Y\, dy + Z\, dz\right) + 2m'\int\left(X'\, dx' + Y'\, dy' + Z'\, dz'\right),$$

we shall have, amongst the rest, the following terms:

$$2\cdot m.\int\left(X\frac{P}{m}.\cos\alpha.\,dx+\frac{P}{m}\cos\beta.\,dy+\frac{P}{m}.\cos\gamma.\,dz\right)$$

$$+2m'\int\left(-\frac{P}{m'}\cos\alpha.\,dx'+\frac{P}{m'}\cos\beta.dy'+\frac{P}{m'}\cos\gamma.\,dz'\right).$$

$$=2.P.\int.\cos\alpha.\left(dx-dx'\right)+\cos\beta\left(dy-dy'\right)+\cos\gamma\left(dz-dz'\right)\Big\}\quad..\ (A).$$

Now, the distance between (m) and (m') remains constant, since they are rigidly connected. Call this distance r, then

$$r^2=(x-x')^2+(y-y')^2+(z-z')^2.$$

$$\therefore rdr=(x-x')\,(dx-dx')+(y-y')\,(dy-dy')+(z-z')\,(dz-dz')$$

$$=r.\cos\alpha\,(dx-dx')+r.\cos\beta.\,(dy-dy')+r.\cos\gamma\,(dz-dz')$$

the first side = zero since $dr=0$, $\therefore$ the second also $=0$,

$$\text{or }\cos\alpha(dx-dx')+\cos\beta\,(dy-dy')+\cos.\gamma\,(dz-dx')=0.$$

Therefore, the sum or expression (A) vanishes. Hence the mutual pressure P entirely disappears from the final sum. The same evidently is true for all such actions between every two particles.

Therefore in the equation,

$$mv^2+m'v'^2+m''v''^2+\&c.=2m\int(Xdx+Ydy+Zdz')$$
$$+2m'\int(X'dx'+Y'dy'+Z'dz')$$
$$+2m''.\int(X''dx''+Y''dy''+Z''dz'')$$
$$+\ \&c.\ ..\ ..\ ..\ ..\ ..\ ..(B).$$

the second side of the equation contains *no unknown tensions* or *mutual pressures*. If instead of a rigid rod, (m) and (m') be connected by a *string*, the preceding reasoning will be precisely the same *if the string remain tight and of the same length*, because then the distance (r) is constant, and $dr=0$. If, however, the string be extensible dr may not$=0$, and then we should have an unknown term Pdr. If the particles be actually *in contact*, of course the preceding reasoning applies to their normal pressure, which is got rid of in the same way, and will not appear in the equation (B). Again, let (m) and (m') mutually attract each other; the law of attraction being any function of the distance (r), may be denoted by $f(r)$. The mutual force will be, therefore, $mm'.f(r)$, the direction being opposite for m and m'. Hence in forming the sum on the second side of equation (B) we should have

$$mm'\int\left\{\cos\alpha(dx-dx')+\cos\beta.(dy-dy')+\cos\gamma(dz-dz)\right\}f(r).$$

$$=mm'\int f(r)dr.$$

[*Example*. Three particles $m\,m'\,m''$, at mutual distances $r_1\,r_2\,r_3$ attracting each other according to inverse square of distance.

$$mv^2+m'v'^2+m''v''^2=-\mu\left(mm'.\frac{1}{r_1}+mm''.\frac{1}{r_2}+m'm''.\frac{1}{r_3}\right)+C.]$$

Again, let there be impact between (m) and (m') during the motion, and suppose both perfectly elastic. Also let P = mutual pressure during contact at any instant. The direction of this normal force is supposed to remain the same during the contact. Then the action may be divided into two portions of equal duration, one (1) of compression, during which (r) the distance between them is continually diminishing and another (2) of expansion during which this distance is continually increasing, till it reaches its original amount. The term therefore $\int Pdr$, which we have to take into account, is the same during these two periods but of contrary signs; therefore the sum = zero, and the term may be neglected. It will also be seen how the

collision of imperfectly elastic bodies may be taken into account; but I shall now go on to the explanation of how this general equation is applied in calculating the *work done* by any machine. The equation is generally written thus:

$$\Sigma.mv^2 = 2\,\Sigma.m\int(\mathrm{X}dx + \mathrm{Y}dy + \mathrm{Z}\ldots$$

the symbol (Σ) denoting the *sum* such terms as that to which it is pre for instance, the second side is e lent to

$$2m\int(\mathrm{X}dx + \mathrm{Y}dy + \mathrm{Z}dz) + 2m'\int(\mathrm{X}'dx' + \mathrm{Y}'dy' + \mathrm{Z}'dz') + \&c.$$

X, Y, Z being the *accelerating* forces which act on the particle whose mass is (m), and whose co-ordinates are x, y, z.

Now it will depend entirely on the student's knowledge of the *principles* of the integral calculus, whether he will be able to attach any definite *physical* meaning to the second side of this equation, or whether he will see nothing but a mere piece of algebraic work to be performed. In the first place, then, it must be remembered — and, indeed, ought never to be forgotten in any physical problem—that an "*integral*" is a "*sum*," and moreover (which is very seldom attended to) that in the expression $\int \mathrm{P}dx$ the factor (dx) is not by any means to be omitted in *forming that sum*. As, however, we are not explaining the differential and integral calculus, a thorough acquaintance with its application to physics is taken for granted; the *use* to which the preceding integrals will be put affording us a good illustration of all such applications. The *work done* by a machine is conveniently me by the number of pounds raised o high—or generally by P × S, P de the pressure overcome through a s by the machine. Hence we see hov veniently the preceding formula is ed to the purpose of calculating work, involving as it does on o the sum of such terms as Pdx, P ing a pressure, and (dx) the through which it is moved. Th will best be seen by taking an case, and going through it. Th shall do in the next paper.

P. S.—There are several mis in my last, as well as in f articles. At present, I shall n notice the following in my last: 620, col. 2, line 17, for "run" "*mn;*" and next col. line 1 "goes" and "describes," read and "describe," omitting the stop. page 620, line 38 of col. 1, the "None" ought not to begin a sentence.

(*To be continued.*)

GEOMETRY OF THE LINE AND PLANE.—BY T. S. DAVIES, F.R.S., L. & E., F.S ROYAL MILITARY ACADEMY, WOOLWICH.

(Continued from p. 542, vol. xlvi.)

Postulates.

1. A plane may be drawn through any given straight line, or through an points, however the line or the points may be situated in space.
2. A plane may be revolved about a straight line in it, till it shall pass th any given point.
3. A plane may be revolved about a line in it, till it coincides with any plane drawn through that line.
4. A line may be drawn through any two given points in a space.
5. A line may revolve about a given point so as to pass through all the poi a given curve anyhow situated, in succession.
6. About any given point as a centre, and with any radius, a sphere m described.
7. In any plane either given or constructed, all the operations of plane geo may be performed.*

---

* For examples, see note C. The student is desired to refer to this note: which, with A and B, given in the next number.

8. A line may be superposed on another line, or a plane on another plane, under the same conditions and in the same manner, as in plane geometry.

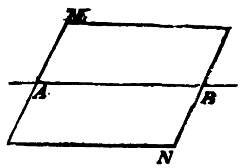
9. A line, a plane, a cone, and a cylinder, may be extended as far as our reasonings may require.

Axioms and Simple Properties.

Although an axiom is, in strictness, an ultimate truth which does not admit of proof in a logical form from any antecedent property or other axiom, yet there are some properties usually classed as propositions, *which* are so elementary, as to render it sometimes doubtful whether the argument employed in their demonstration, when denuded of its mere form, is anything more than a verbal explanation of an ultimate truth. To avoid all discussion of this kind, however, the properties here given are followed by such remarks, or reasonings, as shall place them within the range of admissible truths whatever may be the theory of geometrical philosophy adopted by the reader.

1. If two points be situated in a plane, the straight line drawn through them and indefinitely produced, shall be wholly in that plane.

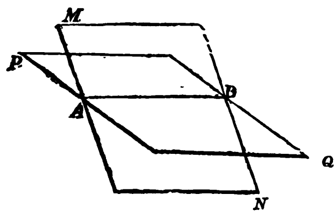
Thus, let MN be a plane, and A,B, two points in it: then the line AB being drawn and indefinitely produced, as to D, this line shall lie wholly in the plane MN.



For, (*Euc. i. di.f.* 7.) the part AB lies in the plane MN; and (*Euc. eax.* 2.) this may be produced indefinitely from A or B. Whence the straight line extended through A and B lies wholly in the plane MN; since there is no limit to the extension of this line prescribed, in either direction, by the definitions of the line and plane.

2. If two planes intersect, their intersection will be a straight line.

Thus, let MN, PQ in two planes which intersect, their line of section AB will be a straight line.



For let A, B, be two points in their line of section; then the straight line which joins them lies in *each* of the planes MN, PQ; and hence in both of them; and, therefore, it is their intersection.

3. The position of a plane is not fixed by only *two* points in it, nor by any number of points all ranged in a straight line.

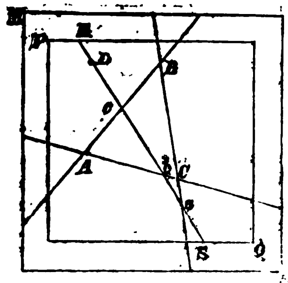
Thus, in the preceding figure two planes pass through the points A, B; and in a similar way it is obvious that any number may.

4. If a plane pass through two points in a line, it passes through every point in that line.

For the line lies wholly in that plane (*ax.** 1.)

5. If two planes coincide in three points which are not in the same straight line, they will wholly coincide however far they may be extended.

* The propositions of this series, whatever be their real character, will be quoted as *axioms*, for the sake both of brevity, and of distinguishing them from the propositions, which are, in the subsequent part, regularly numbered from the commencement.



Thus, let the two planes MN, PQ coincide in the points A, B, C, and let D be any other point in PQ, it will also be in MN.

Draw and produce the lines AB, BC, CA; these will be in both planes, (*ax.* 1.)

Through D draw in the plane PQ, and any line to cut two sides of the triangle ABC in two points, as *a* and *b*. The points *a*, *b* bring in both planes, the line *ab* is in both planes; and the plane MN passing through the two poi *a*, *b*, it passes through every point, including D, in that line. The point D is the fore also in the plane MN. In the same way it appears that every point in o plane PQ, is in the other plane MN; or, in other words, that the planes who coincide.

6. The three sides of a triangle are in one plane.

For they are each in the plane drawn through the three angular points.

7. Two straight lines which meet, or which being sufficiently produced would the are in one plane.

For a plane drawn through one of the lines, and a point in the other, besides t in which they intersect (which is necessary in both lines), gives that point and t point of intersection in the plane so drawn. The second line is therefore also in t plane (*ax.* 4.); and hence they are both in one plane.

8. If from two points in two parallel lines, one in one and the other in the other line be drawn, it will lie wholly in the plane which contains the parallels.

This is only a varied expression of *ax.* 1, in a form to meet a case of frequ occurrence. Euclid makes it a distinct proposition, viz., *xi.* 7.

9. A line and plane can only intersect in one point.

For if the line could meet the plane in a second point, it would lie wholly in t plane, by *ax.* 4.

10. Two planes can only intersect in one straight line.

For if they could meet in any point without that line, they would coincide in thi points (any two in the line, and the one assumed without), which are not in straight line, and hence they would wholly coincide (*ax.* 5).

11. Through the same point in space only one line can be drawn parallel to a given li

For the parallels are in one plane, viz., that which passes through the line a point; and it is a familiar property in plane geometry that only one line can be drawn in that plane.

12. If a plane cut one of two parallel lines, or one of two parallel planes, it w cut the other.

13. If a line cut one of two parallel planes, it will cut the other.

14. A line cannot be parallel to two straight lines except those lines be parallel one another.

15. Through the point in which two lines intersect, one line can be situated at rig angles to both of them.

These four evident facts have been usually assumed by geometrical writers wit out a formal enunciation.

16. If a line meet a plane, every plane drawn through that line will cut the former pla

For, since the line cuts the first plane in a point, the plane through it also pas through that point since the line lies wholly in this second plane.

17. If two planes be given, if a line and plane be given, or if any two figures whi intersect be given, their intersection is to be considered as given.

For, since the mode in which figures in this department of geometry are given, their actual exhibition to the mind in magnitude, species, and position, all interse tions are included in the figures so exhibited.

(*To be continued.*)

NEW, FLAT, ONE-FLUKED ANCHOR.

Fig. 1.

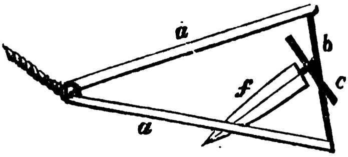


Fig. 2.

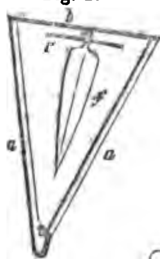


Fig. 3.

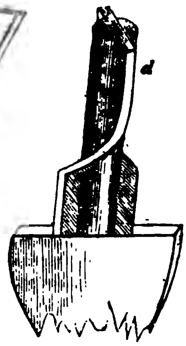


Fig. 4.

Sir,—I send you a design for an anchor intended for small boats, and, in my opinion, in many respects superior to those now in use.

Figure 1 shows the anchor when "in holding," and fig. 2 represents it when stowed away; the letters refer to the same parts in all the figures.

a is a frame consisting of two sides of an isosceles triangle, with a ring at the vertex, to which is to be attached the cable. The bar *b* turns in two holes at the ends of *a a*, and is firmly fixed to the flat fluke *f*. On being lowered into the water, it is plain that the anchor will rest only in two positions, and the weight of the fluke will cause it to catch the ground. No further construction would be necessary for the perfect action of this anchor when used on soft ground, or level hard bottom; but for further and complete security, there is attached the bar *c*, which, being at right angles to the plane of *a a*, will be dragged along the ground so as to turn the fluke downwards. This bar need not project more than a couple of inches; but if it be desired to render the whole apparatus perfectly flat when not in use, the simple modification, shown in figs. 3 and 4 may be given to it. Fig. 4 shows the bar *c*, in the centre of which is a circular aperture with two longitudinal ones, forming part of an inside screw. The part of the fluke, which is between its blade and the bar *b*, is cylindrical, and has two threads of a screw running half a revolution round it. Now, when the anchor is to be stowed away, the bar *c* will be parallel with *b*, but when required for use it must be slipped up the screw, and thus made to assume a position at right angles to its former one.

Of course, the bar *b* must have its ends so forged as to be capable of turning only to about half a right angle on either side of the plane of *a a*.

In the common form of anchor the stock is very liable to foul the cable, and, as well as both flukes, frequently injures the bows of the vessel when being weighed. If the anchor has a movable stock, it is impossible to cross it readily when there is a sudden necessity for speedily casting anchor. Besides this, the projecting upper fluke of the common anchor often fouls the rope attached to it, and not unfrequently in shallow water damages the bottoms of craft floating above it.

All these objections are met in the new construction and obviated, while it renders an anchor most convenient for stowage in small boats in that triangular space which is always floored at the bows.

I am, Sir, &c.,

John MacGregor.

Battersea.

MR. JACOB BRETT'S ELECTRIC PRINTING TELEGRAPH.

Sir,—I am glad that Mr. Brett has been induced to notice personally my remarks on Mr. French's statements. It was not from ignorance of the fact that Mr. House is co-patentee with Mr. Brett, that I mentioned only the name of the latter gentleman in connection with the American telegraph. I really thought that in so doing

my meaning would be sufficiently intelligible.

Mr. Brett may of course, even at this late period of the "controversy," disclaim the statements which have been made for him. He cannot, however, with the same impunity, recede from, or evade, those which he has not merely allowed, but has personally promulgated. The three paragraphs which immediately precede the conclusion of my last letter, in No. 1245 of your Magazine, refer to such statements. I am far from wishing to intrude unseasonably upon Mr. Brett's time, and I therefore willingly accede to his desire, that all questions as to the relative value of the inventions should be suspended. I cannot, however, consent to forego that claim, which I (in common with all your readers) have, to an explanation of assertions which appear so extraordinary, repeated as they have been on so many occasions, but without any proof forthcoming. This is not a question of "merits," but of *facts*.

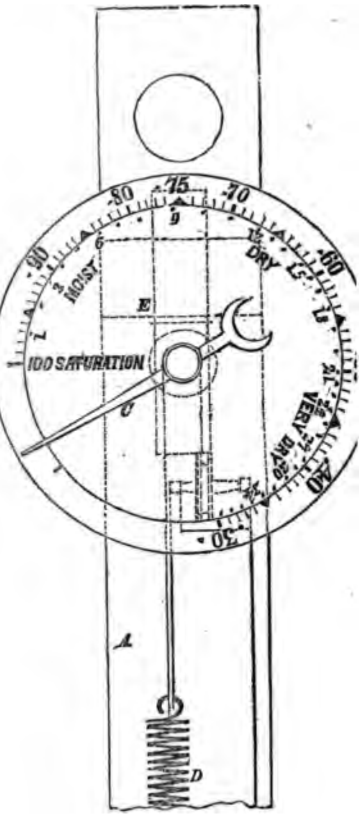
I am, Sir, yours, &c.,
TYRO ELECTRICUS.

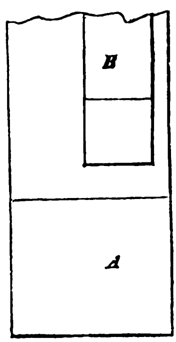
London, June 28, 1847.

SIMMONS'S PORTABLE HYGROMETER.

[Registered under the Act for the Protection of Articles of Utility. E. L. Simmons, of Coleman-street, Proprietor.]

The use of the hygrometer for horticultural purposes (in which its chief value lies) must be greatly promoted by this very improved edition of the instrument. It not only shows at sight the humidity of the atmosphere in decimal parts of the saturation, but furnishes an instantaneous means of ascertaining the dew pent. A is a back-piece, of metal or glass; B, a long thin piece of wood, with the grain running in a transverse direction to its length, which is made fast at the lower end to the back-piece A, and connected at its upper or free end to the axis of the index hand C of the dial-plate E, on the face of which the decimal parts are engraved; and D is a spiral spring which is secured to a bracket projecting from the back-piece A, and connected by a cord to the axis of the index hand C. The constant tendency of the spiral spring and cord is to keep the index hand at what may be called its normal state; while the piece of wood, being elastic, expands and contracts with the increase or diminution of moisture in the atmosphere; and, as it contracts or expands, draws the index-hand round in one direction or the other.





The dew point is ascertained by subtr ing the number under the index-hand fr the temperature of the air at the tir the remainder being the dew point, or temperature in degrees of Fahrenl corresponding to the quantity of moist in the atmosphere.

HORÆ ALGEBRAICÆ. BY JAMES COCKLE, ESQ., M.A., BARRISTER-AT-LAW.

I. SELECTION OF APPROPRIATE RESULTS. EXERCISE.

The selection—from amongst the many results which are often given by our final expression—of the appropriate solution of the given problem, is a subject to which I have made allusion in my Fifth and Sixth *Notes on the Theory of Algebraic Equations* (*a*). As, however, the discovery of rules (should any such exist), which shall enable us to distinguish *à priori* the valid from the invalid results, is a question the importance of which is not confined to any one branch of pure or applied Analytical Science, I have thought it better to separate its discussion from that of the Theory of Equations with which, as I have just observed, it has no exclusive connection. Although commencing with the consideration of this point, I do not intend the present series of papers to be restricted to it. In fact, the Exercise with which the present article concludes is unconnected with the rest of the paper.

In the two "*Notes*" above alluded to will be found instances in which we have been conducted to appropriate results by attending to the symbolical meaning of our formulæ. But we shall also find a case which shows that, as an *exclusive* test, no scrutiny of the symbols will, alone, enable us to arrive at general conclusions. We must, as before remarked (*b*), have recourse to more extended considerations if we wish to obtain criteria universally applicable—supposing, of course, that such criteria exist.

The result obtained at page 491 of vol. xlvi. of this work is undoubtedly the true one, and would seem to be arrived at in a proper manner. Let us bestow a little further consideration upon it.

The solution "40", then, of the question there adverted to, is an *ambiguous* one. It might be urged that the equation

$$x(30-x)=8(30-2x),$$

by means of which the problem may be expressed (*c*), shows that

$$30-2x \text{ or } -50$$

is the "difference" of the "parts" if we use the word "difference" in the sense which it bears in the operations which conduct to the solution of the problem. And we have already seen (*d*) that such an interpretation of the word "difference" enables us to satisfy the algebraical conditions. Nevertheless we have violated the fundamental assumption of the problem, viz. that

$$\text{“ } x=\text{the } \textit{lesser} \text{ part,” } (e)$$

of the two into which the number 30 is to be divided. But "-10" is the "part" which satisfies the above assumption. Hence we may pronounce the result "40" to be an *ambiguous* one.

Next, in solving the problem of page 491 of vol. xlvi., let us assume that

$$x=\text{the } \textit{greater} \text{ part,}$$

then we shall have

$$x(30-x)=8(2x-30),$$

or

$$x^2-14x=240,$$

and $x=7+\sqrt{(\pm1)^2 17^2}=24 \text{ or } -10.$

These results are *complementary* to those obtained on the former assumption. The solution "24," which results from considering the "240" as affected with $(+1)^2$ is the true one. The result "-10" is ambiguous. It will be remarked that the available result in the note (*k*) *supra*, p. 492, is obtained by affecting the "6" with $(+1)^2$.

Again, following a different process, let us assume that x and y are the parts into which 30 is to be divided so as to satisfy the conditions of the preceding problem; then

$$x+y=30 \ldots\ldots (1)$$

$$x-y=\tfrac{1}{8}xy \ldots\ldots (2),$$

and if we substract the square of equation (2) from that of equation (1) we shall have

$$4xy=30^2-(\tfrac{1}{8}xy)^2$$

$$\text{or } (\tfrac{1}{8}xy)^2+32(\tfrac{1}{8}xy)=30^2$$

$$\tfrac{1}{8}xy=-16+\sqrt{(\pm1)^2 30^2+(\pm1)^2 16^2}$$

$$=-16\pm34=18 \text{ or } -50,$$

and considering the 30^2 as affected with $(+1)^2$ we obtain

$$x+y=30$$

(*a*) *Ante*, pages 490 and 516.

(*b*) *Ante*, page 517.

(*c*) Bridge, *Algebra*, Sixth Edition, page 97.

(*d*) *Ante*, page 491, 2d, column.

(*e*) Bridge, place quoted in (*c*).

$$x-y=18$$

$$\therefore x=24, \text{ and } y=6$$

the required parts. Had we taken -50 as the value of $\frac{1}{8}(xy)$ we should have had $x=-10$ and $y=40$, while (2) shows, or rather tacitly assumes, that x is the greater of the two parts. In this solution we are consequently involved in the same inconsistencies as in the preceding ones. But we shall probably find that one will throw light on another.

In fact, in this last solution we see that the ineffective solution is introduced by our giving the double sign $(\pm 1)^2$ to the 30^2. The condition (1) is, since 30 is positive,

$$x+y=(+1)\times 30$$

hence $(x+y)^2=(+1)^2\times 30^2$,

and since the 30^2 is introduced into our processes by means of the last equation, we see why the square root in the above investigation is to be taken positively. Although this observation will in the present paper close my remarks upon the above problem, it is not unlikely that at some future time it will become desirable to consider the relation of the last to the two preceding solutions.

Even when employed as a test of the *admissibility* of results, we must be sure that the rigid interpretation of the meaning of our symbols is not inconsistent with other conditions imposed by the nature of the problem. It will be necessary, therefore, before attempting to employ any test, to see that the formula or expression, to which we may wish to apply it, is unfettered by any extrinsic limitations. The following example will show that we should in certain cases be led into error by losing sight of such extrinsic restrictions:

"Ex. 2. What two numbers are those whose sum multiplied by the greater is 209, and whose difference multiplied by the less is 24?"(*f*)

The equations of the problem are

$$x^2+xy=209\ldots.(3)$$

$$xy-y^2=\ 24\ldots.(4),$$

the solution of which is made to depend upon that of a quadratic in an auxiliary quantity z (*g*), which has two roots $\frac{8}{11}$ and $\frac{3}{19}$ (*h*). Now on the principles of selection heretofore employed, the *latter* would seem to be the appropriat[e] [solu]tion, while, in fact, the *former* is t[he one] which must be adopted. Why, th[en, in] the present instance are we not on[ly not] served, but actually *misled* by ou[r sys]tem of interpretation taken in i[ts] restricted form?

It is because we have not taken [all the] requisites of the problem into cons[idera]tion; it is because the relation [of the] above two equations to one another [has not] be taken into account. Thus, s[uppose] that we have arrived, no matter h[ow, at] 11 as an appropriate value of x. S[olving] (4) with respect to y we obtain

$$y=\frac{x}{2}+\frac{1}{2}\sqrt{(-x)^2-96}$$

$$=\frac{x}{2}-\frac{1}{2}\sqrt{x^2-96}$$

according to our mode of selection gives $y=3$, a value which does not [satisfy] (3). But if we consider the radi[cal] *positive*, (x, as before observed, [being] equal to 11,) we have $y=8$, a value [which] satisfies (3). Our interpretation is, [then,] only invalidated by considerations [purely] collateral, not by any intrinsic defe[ct; it] requires, to perfect it, extension, no[t cor]rection, of our views.

Such extension we must endeav[our to] give them; and we must remembe[r that] similar considerations may be emp[loyed] in every department of science in [which] a result may have more than one [value]. In such case the ambiguity may, at [least] in some instances, be removed by a [refer]ence to the conditions of the prob[lem], and by a reasoning similar to that [which] we have employed in the present [case]. We shall of course have other symb[ols to] deal with than those above consid[ered]. In some branches of analysis we [may], as in the present, have solutions to[o re]stricted as well as others too large. [But] into this I shall not here attempt to e[nter].

Perhaps there are some of your re[aders] who may think it worth while to [solve] the following little Exercise. It is given to illustrate a certain *class* of [pro]positions, and not from any pec[uliar] merits which it possesses in itself:

A farmer on buying a certain numb[er of] beasts gave for each beast a number of p[ounds] LESS *by unity than the* number of be[asts], *but he paid the same price for each b[east], and the expenses of getting them [home] amounted to one pound: A second fa[rmer] on buying the same number of beasts [gave] for each beast* as many pounds MORE

(*f*) Kelland, *Algebra*, (1839), page 150.

(*g*) Ibid. (*h*) Ibid. page 151.

the number of beasts he bought as the first farmer had given less: the expenses of getting these beasts home cost the second farmer one pound: A third farmer bought a number of beasts and gave for each beast one pound more than the number of beasts he purchased; it also cost the third farmer one pound to get the beasts home: On multiplying the total number of pounds paid by the first farmer, by the total number of pounds paid by the second, it was found that the product equalled the total number of pounds paid by the third farmer. Show that the number of beasts bought by the third farmer was the square of the number purchased by each of the others.

(*To be continued.*)

THE CALCULATION OF EARTHWORKS.*

The tendency of even *transcendental mathematics* in the present day, is towards a practical application; and in many of the highest minds may be traced a disposition to merge the highest achievements of symbolism in the search after mundane utility. This is one remarkable feature of the age in which we live; and we trust the day is not distant when the *mécanique terrestre* will receive as much honour for its cultivation, as in the past one has been awarded to the labourers for the perfection of the *mécanique céleste*. The former requires mathematical powers quite as exalted for its due culture as the latter—indeed, we think, even more exalted. Men *now* think more about the *utility* of an inquiry than about either its *difficulty* or its *popularity* in the learned coteries. This is one of the symptoms of a returning healthiness of mind, and of the disrepute into which learned unintelligibility is fast falling. We do not, indeed, belong to the school which would discourage the most profound symbolical research; but we would see every eminent symbolist keeping a due recollection of the ultimate objects which, as a man and a member of the social body, should constitute with him the ultimatum of all scientific studies. The phenomena of astronomy and physical optics are, however, as yet, almost the only subjects which our higher analysts have considered to be *worthy* of mathematical treatment; but in these the success has been commensurate with the transcendent powers employed upon the research. Yet are these the *only* objects worthy of the contemplation of man? Is it nothing that the labours of the geometer in his study shall give manifold increase to the powers of production, or materially lessen the cost of labour by which our daily wants are supplied?

We might quote many authorities in favour of the very different views to which we incline; but that of Mr. Bashforth will be sufficient for our present purpose. We here see a gentleman of high powers and great mathematical attainments, devoting his personal researches to the best mode of accomplishing the practical solution of a problem in mensuration. We see a fellow of the second college (or may be, in some respects, the first) in the University of Cambridge, instructing a surveyor's clerk how to perform his own work with greater facility and more effectively than he could before do it. This is doing homage to the great purposes of all science, and the seeming humility of such an undertaking, whatever the *soi-disant* "learned" may think, bespeaks a far better judgment than spending a life of listless ease within college-walls, and dreaming over barely possible improvements in the minute details of celestial physics.

But this is not all. It should convince our vain, off-handed men of routine—the "rule of thumb" professionals—that mathematical science *is* of real value in practical life. True it is, that experiments upon its value have only been made on a very limited scale; for the contemptible jealousy with which our practical engineers look upon all mathematical inquirers, has rendered it impossible for men of science to ascertain the purposes to which scientific men might best direct their efforts for aiding the practical. They determine, as if by common consent, that men shall serve two apprenticeships, to understand one trade—an apprenticeship to science, ending at three or four and twenty,

* A General Table for Facilitating the Calculation of Earthworks for Railways, Canals, &c. With a Table of Proportional Parts. By Francis Bashforth, M.A., Fellow of St. John's College, Cambridge. London: Bell, Fleet-street, 1847.

and a professional apprenticeship, that may terminate some time before a man is thirty years of age! Our engineers grasp at too much; and, in many cases, only the shadow of the substance is their reward. Witness the Dee Bridge (and "skew-bridges" in general, which are scarcely less unsafe) and "No. 40" of the Brighton locomotives: when any mathematician, who had studied these subjects, would have foretold the fatal results. Many more such are in store, at the cost of her Majesty's lieges, and in illustration of the ignorant and criminal vanity of our "practical engineers." A better order of men, too, than the "Royal Engineers" who are appointed inspectors of railways, must be brought into the engineering profession. And they must be men to whom we can safely entrust a *veto* on *all works* which involve the public interests and the public safety. True, such a veto exists now, but *who exercises it?* We need only recall to our readers' recollection, that the highest authority (Sir Charles Pasley) amongst the *Royal Engineers*, sanctioned the opening of the Chester Bridge. The poor old gentleman "looking very foolish" (as he is said to have done before the coroner's inquest) is little compensation to the bereaved families of the sufferers by that sad catastrophe; nor is it likely to add to the comfort of those who may be conscious that they are exposed to half-a-dozen similar dangers upon every line they travel over! We leave this painful subject, however, *for the present*, and return to that from which we had, almost unconsciously, been led astray. The considerations belonging to both, being nearly identical, must be our apology.

There is one principle assumed in all the Earthwork Tables that have yet been published: viz., that the surface of the cutting is a plane. This is, perhaps, a condition that is seldom fulfilled with any degree of rigour; but for short distances (as a chain in length) the difference is probably such as to deserve but little notice in large estimates, the opposite errors nearly balancing each other when extensive cuttings are to be made. Without a more rigid scrutiny into the details than we have time to make, we should, however, feel some hesitation in pronouncing positively upon this question. We trust that the long-continued state of precarious health of one of our correspondents who commenced a course of inquiry into this subject, will not compel him to leave his investigations unfinished. For the present, at any rate, *we* shall not discuss it; but take the usual view for granted, as a sufficiently near approximation.

In this case the excavation between the limits of the chain-length is the ordinary "truncated triangular pyramid" of our books on mensuration; having a segment cut off by a plane parallel to one of the edges of the prism. It is under this very convenient form for calculation that Mr. Bashforth views the solid of excavation. The investigations are given in a perfectly scientific manner, and perfectly free from all affectation of notation, which, from being unusual, would be unintelligible to the great mass of his readers. In fact, the only symbol that does not occur in our oldest books of mensuration, in this work, is $\Sigma\ (\nabla)$, signifying the sum of all the volumes of the separate chain-cuttings.

The example of the use of the Table, at page 7, is clearly explained, and it illustrates the use of the Table completely for cases of ordinary occurrence.

Again, cuttings have usually been limited within sixty-five feet depth; probably from it being deemed that when the hill exceeds that height, it would be cheaper to tunnel than to excavate an open road. This may not always, however, be true, as the nature of the ground may be such as to render a deeper cutting more feasible than a tunnel. To meet these cases, Mr. Bashforth has extended the *use* of his table to any multiple of sixty-five feet, without increasing the *actual table* itself.

Further, the author has given an elegant and original formula for interpolating the volumes, where the cuttings are any decimal or centesimal parts of a foot more than any pair of integers in the table. This is of the utmost importance in estimates for

stracts and for work actually done. It ems to fulfil the precise purpose contemplated by Mr. Colvin in our last number. effect this more readily, Mr. Bashforth devised a very commodious slide-rule for ling by inspection the values of $2a + b$ and $+ a$, which occur in his formula; and then whole process is reduced to the use of general table precisely as in the ordinary es.

ome judicious remarks on "the interpoon of heights" closes this little volume; olume which should become *the* handk of every person whose professional es require even occasional calculations his nature. Were it only, that it is more nsively applicable than any other in tence, we could recommend it most corly to our readers; but when they learn the use of it *involves only half the ur* of all other tables constituted for the e purpose, we offer the strongest of all mmendations, that founded on *the value ime.*

Ve would fain hope that we shall ere see Mr. Bashforth producing other ofs than this of the great value of matheical science to the engineering profes-; and we take our leave of his little k, with a sincere hope that his career be as bright as his powers and acquirets deserve.

DISCOVERIES OF THE PAST YEAR.

rom the Address of the President of the Oxford ing of the British Association, Sir Robert s, Bart.—As reported in the *Athenæum.*]

ides in the Air as well as in the Sea.

he doctrine of the influence of the moon of the sun on the tides was no sooner blished than it became eminently proe that an influence exerted so strongly a fluid so heavy as water, could not have the lighter and all but imponderfluid of air under its grasp. I speak of the influence attributed to the moon e popular language and belief of nations ent and modern,—of Western Europe of Central Asia, in respect to disease; of the direct and measurable influence he moon and of the sun in respect to the It is now clear, as the result of the ervations at St. Helena by my friend . Sabine, that, as on the waters, so on atmosphere, there is a corresponding uence exerted by the same causes. There are tides in the air as in the sea; the extent is, of course, determinable only by the most careful observations with the most delicate instruments; since the minuteness of the effect, both in itself and in comparison with the disturbances which are occasioned in the equilibrium of the atmosphere from other causes, must always present great difficulty in the way of ascertaining the truth—and had, in fact, till Col. Sabine's researches, prevented any decisive testimony of the fact being obtained by direct observation. But the hourly observations of the barometer, made for some years past at the Meteorological and Magnetical Observatory at St. Helena, have now placed beyond a doubt the existence of a lunar atmospheric tide. It appears that, in each day, the barometer at St. Helena stands, on an average, four-thousandths of an inch higher at the two periods when the moon is on the meridian above or below the pole, than when she is six hours distant from the meridian on either side; the progression between this maximum and minimum being moreover continuous and uninterrupted, thus furnishing a new element in the attainment of physical truth; and, to quote the expression of a distinguished foreigner now present, which he uttered in my own house when the subject was mentioned, "We are thus making astronomical observations with the barometer"—that is, we are reasoning from the position of the mercury in a barometer, which we can touch, as to the position of the heavenly bodies, which, unseen by us, are influencing its visible fall and rise. "It is no exaggeration to say,"—and here I use the words of my friend, the Rev. Dr. Robinson,—"that we could even, if our satellite were incapable of reflecting light, have determined its existence—nay, more, have approximated to its eccentricity and period."

Animal Electricity.

In physiology, the most remarkable of the discoveries, or rather improvements of previous discoveries, which the past year has seen, is, perhaps, that connected with the labours of the distinguished Tuscan philosopher, Matteucci; who, on several former occasions, has co-operated with this association in the sections devoted to the advancement of the physical and physiological sciences. I refer in this instance to his experiments on the generation of electric currents by muscular contraction in the living body. This subject he has continued to pursue; and, by the happy combination of the rigorous methods of physical experiment with the ordinary course of physiological research, Professor Matteucci has fully established the important fact of the

existence of an electrical current—feeble, indeed, and such as could only be made manifest by his own delicate galvanoscope—between the deep and the superficial parts of a muscle. Such electric currents pervade every muscle in every species of animal which has been the subject of experiment; and may, therefore, be inferred to be a general phenomenon of living bodies. Even after life has been extinguished by violence, these currents continue for a short time; but they cease more speedily in the muscles of the warm-blooded than in those of the cold-blooded animals. The Association will find his own exposition of the physiological action of the electric current in his work, *Leçons sur les Phénomènes Physiques des Corps Vivants*, 1847.

The delicate experiments of Matteucci on the Torpedo agree with those made by our own Faraday upon the *Gymnotus electricus*, in proving that the shocks communicated by those fishes are due to electric currents generated by peculiar electric organs, which owe their most immediate and powerful stimulus to the action of the nerves.—In both species of fishes the electricity generated by the action of their peculiar organized batteries—besides its benumbing and stunning effects on living animals—renders the needle magnetic, decomposes chemical compounds, emits the spark, and, in short, exercises all the other known powers of the ordinary electricity developed in inorganic matter or by the artificial apparatus of the laboratory.

Etherization.

The influence of the vapour of ether on the human frame is a discovery of the last year, and one the value of which in diminishing human pain has been experienced in countless instances, in every variety of disease, and especially during the performance of trying and often agonizing operations. Several experiments on the tracts and nerve roots appropriated respectively to the functions of sensation and volition have been resumed and repeated, in connection with this new agency on the nervous system. Messrs. Flourens and Longet have shown that the sensational functions are first affected, and are completely, though temporarily, suspended under the operation of the vapour of ether; then the mental or cerebral powers; and, finally, the motor and excito-motor forces are abrogated. It would seem that the stimulus of ether, applied so largely or continuously as to produce *that* effect, is full of danger—and that weak constitutions are sometimes unable to rally and recover from it; but that when the influence is allowed to extend no further than to the suspension of sensation, the recovery is as a general rule complete. It is this remarkable property of ether which has led to its recent application with such success as may well lead us to thank God, who, in His Providence, has directed the eminent physicians and surgeons amongst our brethren in the United States to make this discovery;—a discovery which will long place the name of Dr. Charles J. Jackson, its author, among the benefactors of our common nature.

At the same time, much careful observation, on the *modus operandi* of this most singular agent, seems still requisite before a general, systematic, safe, and successful application of it can be established for the relief of suffering humanity.

The Electric Telegraph.

The extension of the means of communication by the Electric Telegraph is yearly facilitating intercourse, almost as rapid as light or as thought, between distant portions of England, and between distant provinces in the vast empire of our Queen.

The last pamphlet which I had in my hand before leaving home yesterday, was a Report presented to the Legislative Council and Assembly of New Brunswick, relative to a project for constructing a railway, and with it a line of electro-magnetic telegraph, from Halifax to Quebec.

Distance is time; and when by steam, whether on water or on land, personal communication is facilitated, and when armies can be transported without fatigue in as many hours as days were formerly required; and when orders are conveyed from one extremity of an empire to another almost like a flash of lightning, the facility of governing a large state becomes almost equal to the facility of governing the smallest. I remember, many years ago, in the *Scotsman*, an ingenious and able article, showing how England could be governed as easily as Attica under Pericles: and I believe the same conclusion was deduced by William Cobbet, from the same illustration.

The system is daily extending. It was, however, in the United States of America, that it was first adopted on a great scale, by Professor Morse, in 1844; and it is there that it is now already developed most extensively. Lines for above 1,300 miles are in action, and connect those States with her Majesty's Canadian provinces; and it is in a course of development so rapid, that, in the words of the report of Mr. Wilkinson to my distinguished friend, His Excellency Sir W. E. Colebrooke, the Governor of New Brunswick, to which I have just adverted, "No schedule of telegraphic lines can now be relied upon for a month in succession, as hundreds of miles may be added in that

space of time. So easy of attainment does such a result appear to be, and so lively is the interest felt in its accomplishment, that it is scarcely doubtful that the whole of the populous parts of the United States will, within two or three years, be covered with a telegraphic network like a spider's web, suspending its principal threads upon important points along the sea-board of the Atlantic on one side, and upon similar points along the Lake frontier on the other." I am indebted to the same Report for another fact, which I think the Association will regard with equal interest: "The confidence in the efficiency of telegraphic communication has now become so established, that the most important commercial transactions daily transpire, by its means, between correspondents several hundred miles apart. Ocular evidence of this was afforded me by a communication, a few minutes old, between a merchant in Toronto and his correspondent in New York, distant about 632 miles." I am anxious to call your attention to the advantages which other classes also may experience from this mode of communication, as I find it in the same Report. When the *Hibernia* steamer arrived in Boston, in January 1847, with the news of the scarcity in Great Britain, Ireland, and other parts of Europe, and with heavy orders for agricultural produce, the farmers, in the interior of the States of New York,—informed of the state of things by the Magnetic Telegraph—were thronging the streets of Albany with innumerable team-loads of grain almost as quickly after the arrival of the steamer at Boston as the news of that arrival could ordinarily have reached them.—I may add, that, irrespectively of all its advantages to the general community, the system appears to give already a fair return of interest to the individuals or companies who have invested their capital in its application.

The larger number of members of this Association have probably already seen in London an exhibition of a Patent Telegraph which prints *alphabetical* letters as it works. Mr. Brett, one of the proprietors, obligingly showed it to me: and stated that he hoped to carry it into effect on the greatest scale ever yet imagined on the American Continent. Professor Morse, however, does not acknowledge that this system is susceptible of equality with his *telegraphic* alphabet for the purpose of rapid communication; and he conceives that there is an increased risk of derangement in the mechanism employed.

I cannot refer to the extent of the lines of the Electric Telegraph in America without an increased feeling of regret that in our own country this great discovery has been so inadequately adopted. So far, at least, as the capital is concerned, the two greatest of our railway companies have not, I believe, yet carried the Electric Telegraph further from London than to Watford and Slough: an enterprise measured in the United States by hundreds of miles being measured by less than scores in England.*

In England, indeed, we have learned the value of the Electric Telegraph as a measure of police in more than one remarkable case: as a measure of government it is not less important:—from the illustration which I have drawn from America, it is equally useful in commerce; but as a measure almost of social intercourse in the discharge of public business it is not without its uses also. The day before yesterday, I had an opportunity of examining the telegraph in the lobby of the House of Commons, by which communications are made to and from some distant Committee-room. As a specimen of the information conveyed from the House is the following:—"Committee has permission to sit until five o'clock;" and among the questions sent down from the Committee are the following:—"What is before the House?" "Who is speaking?" "How long before the House divides?"

* The Learned President has considerably underrated the extent to which the Electric Telegraph has been carried in this country. From the subjoined list, it will be seen that we have nearly 1,000 miles in actual operation:

	Miles.
Eastern Counties—Colchester and Cambridge lines; Hertford, Ely, and Peterborough, and Thames Junction Branches	180
Eastern Union—Colchester to Ipswich	17
Norfolk Line—Brandon to Yarmouth	58
Midland Counties—main lines and branches	210
Great North of England	54
Newcastle and Darlington—main line and branches	55
Great Western—London to Slough	19
South-Eastern—main line and branches	152
South-Western	99
Blackwall	5
South Devon	20
Wolverton and Peterborough	57
Hull and Selby—Extension to Milford	41
York and North Midland	23
	990

DECIMAL NOTATION.

Sir,—in No. 1246 your correspondent, "W. O.," on decimal notation for *moneys*, does not explain his *new method* of writing shillings and pence. For 4s. 2d. he writes 42; for 14s. 5d.··$\bar{4}$5; and for 12s. 10d.··$\bar{2}\bar{0}$. Now, as he neither states the scale nor radix of the quantities thus altered, it cannot be clearly understood how he finds the *amount* of the several given sums; nor does he explain how 10*l.* 11s. 11d. are *identical* with 10*l.* $\bar{1}\bar{1}$. If, as I suppose, he means that these figures having a small horizontal line over them are to be considered as quantities having *unity* prefixed, then they may be added in the usual way of finding the amount of sums in £ s. d. But, in my humble opinion, this would be rather a dangerous change; for, accidently, the wrong digit might be thus marked; or what would be equally bad, omitted altogether. But perhaps "W. O." will favour your readers with an explanation, as there may be more in his method than meets the eye.

I am, Sir, yours, &c.,

W. R.

Paddington, June 28, 1847.

ABATE'S SEWER TRAP.

Sir,—If your correspondent, J. L. Hale, Well-street, Hackney, wishes to try the correctness of his assertions respecting Abaté's Sewer Trap, he can do so by applying at the Society's house in the Adelphi, where the model sent has undergone a variety of severe tests and experiments before the Committee; the more so as it was sent in competition with others, and was not found subject to the fault he mentions, but on the contrary was so far successful. I expect that very much depends upon the proper proportions of the various parts in which Mr. Hale may have failed with his former trial, and I believe he will find the ball in this is not raised sufficiently high to occasion the descending water to take the form of a whirlpool; in washhand basins that was found to be the case, but not so as the present one is arranged. How far it will act satisfactorily has to be tried, and I understand is about to be so; but I am at present chiefly anxious to correct the error stated by you, "that neither Mr. Abaté nor the Society have ever tried this apparatus"—which is not the fact. I am, Sir, &c.,

E. B.

GUN-COTTON POWER ENGINE.

Mr. Fox Talbot has recently taken out a patent for the application of the explosive property of gun-cotton to produce a vacuum alternately on each side of the pistor engine. At the bottom of the cylin each side, are two circular holes in the explosive material is supplied by lar slide. Passing through the cylin platina wire, for the purpose of being by the galvanic battery, and thus e the cotton. In preparing the cylind tubular slide is first filled with gun- in each division thereof, so as to allo be exposed to the immediate act heat in passing through the cylind being brought in contact with the wire, taking care that one charge sha been discharged before another is duced—and thus causing, by repeat plosions, a motive power for giving to machinery, &c.; such power being lated entirely by the quantity of ex material employed.

RAILWAY ACCIDENTS AND LOCK BUFFERS.

Sir,—Will you allow me a ver space in your excellent journal to Sir George Cayley, Bart., that I hav long time anterior to the first of 1847, conceived the idea of having buffers, though, like him, I delaye lishing the same until the 15th present month, when I addressed t lowing letter to the Editor of the and which appeared in that journal 16th:—

"*To the Editor of the Times.*

"Sir,—In the excellent letter 'Engine-driver,' which appeared in columns last Monday, it is stated that danger is to be apprehended from the not meeting each other at their proper c in a case of collision. Why not remo cause of apprehension and danger, by the buffers made concave at one e convex at the other? This plan wou tainly facilitate their meeting at centres, if not altogether remove the bility of a repetition of the dreadful life which took place at Wolverton.

"June 15. CYM

Therefore, I hope that Sir Geor concede to me the *priority of publi* and share the *honours of invention.*

I am, Sir, &

O. R—

June 26th, 1847.

YATES' PATENT IMPROVEMENTS IN FURNACES.

[Patentee, Mr. James Yates, Masborough, Y Patent dated December 14, 1847.]

The patentee states, that it is u keep the charge, in blast furnaces o

nary construction, for as long a time as is compatible with the iron made; and that it is deemed beneficial to continue *the cementing process*, which is the result of the ironstone, or ore, and fuel, being subjected to a great degree of heat for several days; but that he believes this system of operation to be erroneous.

Again; under the system which has hitherto prevailed, furnaces are kept filled up to the funnel-head, through which the flame and unconsumed products pass on escaping from the charge; and these furnaces are constructed in the form of two cones united at their bases, or of a cylindrical form at top; both of which forms of construction offer scarcely any obstacle to the free escape of caloric with the unconsumed products.

Now Mr. Yates proposes *firstly*, to arch in the upper part of the furnace, and diminish its height, in order that a very considerable portion of heat, instead of escaping as heretofore, may, after striking against the even surface of the dome, be deflected on the top surface of the "burden" and absorbed by it. *Secondly*, to place feed-doors, by which the material may be introduced in the side, at that point of junction between the dome and the bottom part of the furnace which allows of the largest surface of the burden being exposed to the action of the deflected heat (care being taken to maintain a sufficient and uniform space between the dome and top of the "burden" for the purposes of reverberation); by which mode of charging the furnace the "burden" is hollow in the centre, and therefore offers less resistance to the blast, which is regulated by means of dampers suitably placed in the chimney. And *thirdly*, to employ a greater number of tuyeres, and to distribute them more equally round the hearth of the furnace than has yet been customary; and to provide each tuyere with a separate house, in order that the blast may act more regularly on the "burden."

The results of these alterations are stated to be saving in the prime cost of erection, and economy both in fuel and in engine power.

Mr. Yates instances a furnace, built according to his invention, which was 20 feet from the hearth to the top of the "burden," and had six tuyere pipes of $\frac{7}{8}$ths of an inch in diameter; with this furnace he produced, employing a hot blast at a pressure of $1\frac{1}{4}$ lbs. to the square inch, 110 tons of iron, from lean Derbyshire ore, in one week.

The patentee proposes to adapt his plan of construction to existing furnaces, by building the dome in the top, or other part of the shaft, and providing feed doors, together with the necessary holes for the extra number of tuyere pipes.

After pointing out various modifications of which his invention is susceptible, such as, the substitution for tuyere pipes, of a circular passage, with grating to keep in the "burden," Mr. Yates proceeds to describe a peculiar apparatus for feeding by the chimney instead of by side doors, which enables him to obtain the same result, viz., the distribution of the material around and upon, and not in, the centre of the "burden." The apparatus referred to is fixed in the dome, and consists of a cone, having an aperture in its centre for the passage of unconsumed products, and is adjusted to the required size. The cone is made fast to a lever passing through the chimney, and weighted at the outside end; so that when there is no disturbing force, its weight shall keep the cone wedged tight up into the dome, and leave no room for the escape of any vapour or caloric, except through the aperture. A feed-box is suspended in the chimney, and has a conical bottom, similarly connected to a weighted lever, which, when the box is filled, falls down, and allows the passage of the material; the centre aperture of the under cone being covered by the bottom of the feed-box. The weight of the material falling on the surfaces of the under cone, overcomes the weight at the end of the lever, and depressing the cone, passes into the furnace, around the sides. When there is no longer any weight on either the cone portions of the dome, or the conical bottoms of the box, they both return to their places.

Other modifications described in this specification are, the connecting two or more furnaces to a common chimney, by flues provided with dampers to regulate the draught: the making the furnace of as great a diameter at the bottom, just above the hearth, as at the other point of junction with the dome, or even greater: and a peculiar construction of tuyere box, to avoid, in a great measure, the melting of the tuyere pipes.

The patentee describes, lastly, some improvements relating to steam-engines and cylinders employed in blasting, which may be said briefly, to consist in working two engines together, by connecting the slide valves and rods of the one to the piston-rod of the other, and *vice versâ*; so that the piston at work shall open the valves of the one at rest; and in using an elastic cylinder attached immovably at one end to the main, and at the other to the piston-rod. By the use of this elastic cylinder, Mr. Yates states that a more regular pressure of the blast may be obtained.

NOTES AND NOTICES.

Magic Mirrors.—An interesting paper was read at a late meeting of the Paris Academy of Sciences, by M. Stanilas Julian, on the metallic mirrors made in China, and to which the name of "Magic Mirrors" has been given. Hitherto all attempts by Europeans to obtain information as to the process, in the localities where they are manufactured, have proved failures; some of the persons applied to being unwilling to reveal the secret, and others being ignorant of the process. These mirrors are called magical, because if they receive the rays of the sun on their polished surface, the characters, or flowers *en relief*, which exist on the other side, are faithfully reproduced. The following information has been obtained by M. Julian, from an author named Ou-tseu-hing, who lived between 1260 and 1341. This author says:—"The cause of this phenomenon is the distinct use of fine copper and rough copper. If, on the under side, there be produced, by casting in a mould, the figure of a dragon in a circle, there is then engraved deeply on the disc a dragon exactly similar. Then the parts which have been cut are filled with rather rough copper, and this is, by the action of fire, incorporated with the other metal, which is of a finer nature. The face of the mirror is next prepared, and a slight coating of tin is spread over it. If the polished disc of a mirror so prepared be turned towards the sun, and the image be reflected on a wall, it presents distinctly the clear portion and the dark portion, the one of the fine and the other of the rough copper." Ou-tseu-hing states that he had ascertained this by a careful inspection of the fragments of a broken mirror.

Etherization of Vegetables.—M. Clemens, Professor of Natural Sciences at the College of Vevay, has lately addressed a memorial to the Academy of Sciences of the Vaud, giving the results of experiments made by him in order to ascertain the effects of ether upon vegetables; from which he finds plants may be etherized as easily as man and other animals. He says:—Take a branch of the *berberis vulgaris*, the common barberry, and put it under a drinking-glass, with a small quantity of ether, for a minute at most if in the sun, and during three minutes at most if in the shade, but at at a temperature of not less than 12 degrees of Reaumur (59 degrees Fahrenheit); and when it is withdrawn, it will be found, on touching the stamina at their base, that they have lost all their irritability, which will not return in the first instance until after a considerable time, the influence of the ether having been much stronger. In the second case, on the contrary, the primitive irritability is recovered in half an hour. The plant may be etherized a second time; and this second etherization must not be any longer than the first; and after half an hour the plant resumes all its vigour. To etherize a sensitive plant, *mimosa pudica*, the process must be continued for 8 or 10 minutes, and a proportionably longer time in the shade. The acetic, chlorhydric, and nitric ethers act in the same manner; but the sulphuric and acetic ethers are the most effective.

LIST OF ENGLISH PATENTS GRANTED FROM JUNE 26, TO JUNE 29, 1847.

Robert Wilson, of Low Moor Iron Works, Bradley, Yorkshire, engineer, for improvements in machinery and the arrangements thereof for forging, stamping, punching, cutting, and pressing metals and other substances. June 26; six months.

Ureli Correlli Hill, of New York, U. S., professor of music, for a mode or modes of producing musical sounds. June 28; six months.

William Edward Newton, of Chancery-lane, civil-engineer, for certain improvements in manufacturing wheels. (Being a communication.) June 28; six months.

Henry Hornblower, of Dalgleish-place, Commercial-road, Middlesex, engineer, for certain improvements in obtaining motive power. Jur months.

Frederick Chaplin, of Bishops Stortford, shire, tanner, for improvements in wheel way carriages. June 29; six months.

Thomas Young, of Queen-street, C merchant, for improvements in card retaining or fastening papers, deeds, an June 29; six months.

Paul Gilbert Prelier, of Rue de Riv gentleman, for improvements in the ma of dry sulphuric acid, and in the manu smoking or Nordhausen sulphuric acid. communication from abroad.) June 29; si

MONTHLY LIST OF PATENTS GRAN SCOTLAND FROM THE 24TH OF THE 21ST OF JUNE, 1847.

Reginald James Blewitt, of Llantarna Newport, Monmouth, esq., for improvem manufacture of malleable iron. May 24.

Solomon Leatham, of Leeds, York, o for improvements in roving and spinning other fibres. May 24.

Christian Schiele, of Frankfort-on-the-M now of Manchester, Lancaster, mechan certain improvements in machinery or for condensing steam, which said impr are also applicable to other similar purpo 28.

Jean Marie Fourmentin, of New Bri Blackfriars, gent., for improvements in t facture of carbonate of lead. May 28.

Thomas Bartlett Simpson, of Threadnee London, gent., for certain improvemen pelling, and in machinery employed therei

Edmund Morewood, of Thornbridge, D chant, and George Rogers, of Sterndal same place, gent., for improvements in t facture of iron into sheets, plates, or oth in coating iron, and in preparing iron f and other purposes. June 7.

George Augustus Huddart, of Brynki von, esq., for certain improved apparat cultivation of land. June 7.

John Hill, of Hulme, near Manchester, machine maker, for improvements in weaving certain kinds of cloth. June 9.

Francis Bowes Stevens, of Haboken, H the State of New Jersey, in the United Stat rica, engineer, for improvements in apply and apparatus to ships and vessels to their speed. (Being a communication fro June 9.

Elijah Galloway, of Buckingham-stree Middlesex, civil engineer, for improveme tary engines, and in locomotive carriages, and wheels for carriages. June 11.

John Lane, of Oriel-street, Liverpool, b improvements in railway carriages and June 11.

Alfred Vincent Newton, 66, Chancery-l dlesex, mechanical draughtsman, for apparatus to be applied to steam boilers. communication from abroad.) June 11.

John Healey, of Bolton, Lancaster, maker, for a new and improved woven f also for certain improvements in mac producing the same. June 15.

Charles Larrad, of Leicester, machinis provements in machinery for cutting woo manufacture of bobbins and other articles.

Thomas Russell Crampton, of the Middlesex, engineer, for improvements i tive engines. June 15.

Alfred Brett, of Holborn-bars, gent., a Little, of High Holborn, electrical eng improvements in electric telegraphs, a rangements and apparatus to be used th therewith, part of which improvements a plicable to time-keepers and other useful June 15.

Pierre Frederic Gorigy, of Leicester-square, Middlesex, gent., for improvements in apparatus and machinery for raising, lifting, and otherwise moving heavy bodies. June 16.

Samuel Kenrick, of Handsworth, Stafford, iron founder, for certain improvements in preparing or forming moulds for casting metal. June 18.

George Taylor, of Holbeck, near Leeds, York, for mechanic improvements in the construction of engines and carriages to be used on railways. June 18.

Frederic Theodore Philippi, of Bellfield Hall, Lancaster, calico printer, for certain improvements in machinery or apparatus for stretching and finishing woven fabrics. June 18.

Francis Preston, of Ardwick, near Manchester, spindle maker, for certain improvements in machinery or apparatus to be used in the preparation of cotton and other fibrous substances for spinning. June 21.

LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED UNDER 6 AND 7 VIC. CAP. 65.

Date of Registration.	No. in the Register.	Proprietors' Names.	Address.	Subject of Design.
June 24	1106	E. Looms .... and W. P. Stanley...	Whittlesea, Cambridgeshire... Peterborough, Northamptonsh	Improved hand seed-dibble.
25	1107	James Cocks................	18, Allen-street, Lambeth.........	Day and night signal.
,,	1108	Henry Greaves............	Birmingham..............................	Treble lock-frame for carpet and other bags.
26	1109	James Furrell.............	Vicarage-place, Kensington	File for filing papers.
,,	1110	John Paltrineri	4, South-street, Finsbury..........	Binding needle.
28	1111	Henry and John Gardner	453, Strand, lamp manufacturers	Candle-shade holder support.
,,	1112	John Cornes.................	Barbridge, near Nantwich, Cheshire..................................	Improved chaff engine.
,,	1113	George Oxley.............	19, Old Nicholl-street, Church-street, Bethnal Green............	Ottoman music-stool.
29	1114	John Masters	Welford-place, Leicester	Waistcoat back-strap.
,,	1115	Henry Barber..............	Davis-street, Oxford-street.......	Double-bottomed pan for a shower-bath.

CONTENTS OF THIS NUMB

LONDON: Edited, Printed, and Publi Joseph Clinton Robertson, of No. 16 street, in the City of London.—Sold l W. Galignani, Rue Vivienne, Paris; M Co., Dublin; W. C. Campbell and Co., H

Mechanics' Magazine,

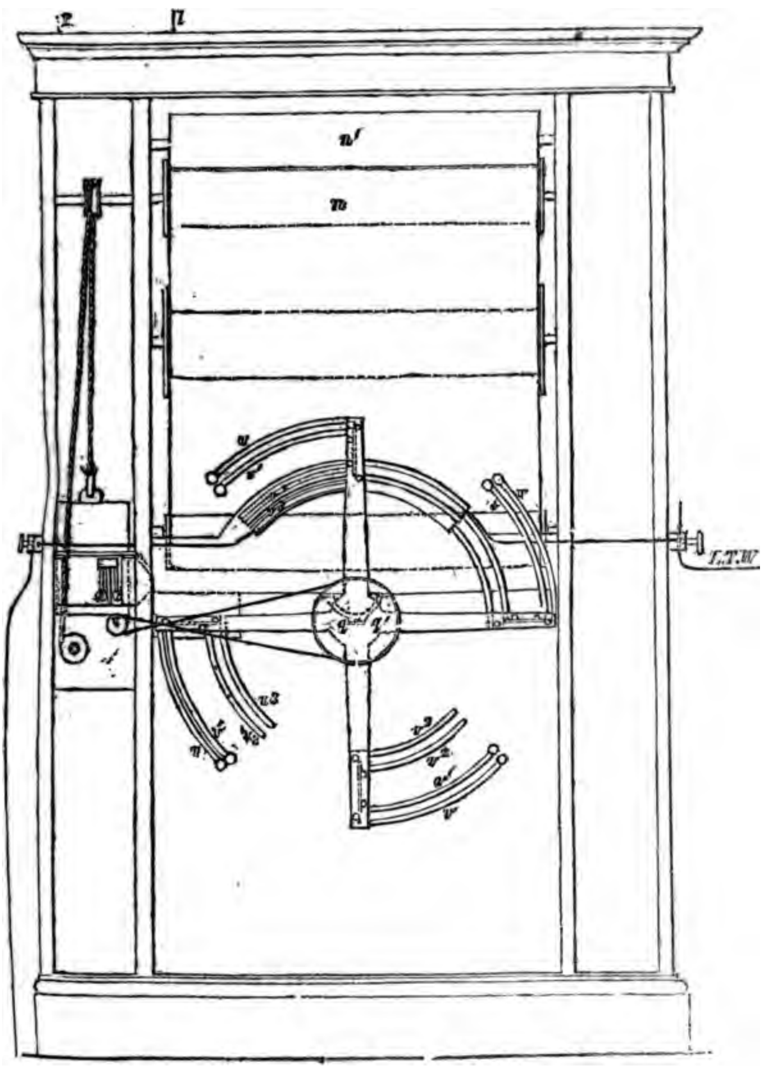
MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 1248.] SATURDAY, JULY 10. [Price 3d.

Edited by J. C. Robertson, 166 Fleet-street.

BAIN'S NEW SYSTEM OF ELECTRO-TELEGRAPHIC COMMUNICATION.

Fig. 4.



MR. BAIN'S NEW SYSTEM OF ELECTRO-TELEGRAPHIC COMMUNICATION.

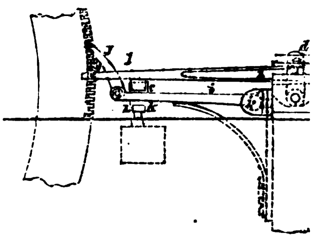
[Patent dated 12th December, 1846. Specification enrolled 12th June, 1847.]

In our first publication (No. 1245) after the enrolment of Mr. Bain's specification of his new system of electro-telegraphic communication, we gave a hasty, but substantially correct, abstract of its contents. In a case like this, however, where the invention patented is one of universal interest, and destined, in all probability, to exercise a greater influence on society than any other of modern times —not even excepting "all-powerful" steam—it is hardly to be expected that anything short of the fullest possible information on the subject should satisfy the public mind. We now propose, therefore, to publish the specification *in extenso*, in successive numbers of our journal, with engravings of as many of the accompanying drawings as may be necessary to a perfect understanding of the text. And, in so doing, we hope to minister to something better than mere abstract curiosity; for, to hasten the universal adoption of any system deserving of such adoption, and to stimulate the development of any additional improvement of which it may be susceptible, nothing can be more conducive than a clear understanding by the public of what the system is, both in principle and practice. We give in our present number the whole of the first arrangement of apparatus described by Mr. Bain.

The Specification.

In the arranging and combining apparatus into electrical telegraphs, various means have been resorted to for transmitting and for receiving communications. Amongst others, it has been proposed by Mr. Morse to prepare the communications which are to be transmitted (through electric circuits) into mechanically-composed forms, which may be likened to forms of type, and then, by suitable mechanism, to transmit the subject of such composed forms through electric circuits to other mechanism, suitably arranged for marking paper by mechanical means, with signs, or indents, or marks with pencil or ink, employing electro magnets as the means of actuating the mechanical marker,—the paper being moved by clock-work, each act of marking requiring the force of the electro magnet to put the marking instrument into motion, and then the magnetic force to be broken, in order to remove the marker from the paper. Mr. Davy proposed to employ chemically-prepared fabrics, to receive electrical communi-

Fig. 1.



cations transmitted through electric brought into action by means of fing acted on by the person making the nication. Mr. Davy used electro for governing the movement of the cally-prepared fabrics; and the marks were produced by the pa electric currents through the che prepared fabrics, each mark or sign r the electric circuit to be made and and the receiving chemically-prepa face allowed to move a distance electro magnet, the making and bre the attraction between it and its a being necessary for each time of m And I did, in my former patent May, 1843, describe a mode of tran and receiving electrical telegraph co cations, by using a mechanically-c form, acting with apparatus so arr to transmit the subject thereof electric circuits, receiving the sam chemically-prepared paper, in such as to produce a fac simile of the co surface to the chemically-prepared by a multitude of lines of dots, ca electric currents passing through th cally-prepared paper,—the pape moved progressively by means of ap acted on by a magnet. In all thes the use of magnets necessarily reta speed of transmitting and receivi communication.

Now, the first part of my inventi sists of so arranging or combining ap for transmitting and receiving e communications, that the commu may be first mechanically compos then transmitted through an electric or circuits, in such manner that the of the composed communication received on to chemically-prepared without requiring electro or other to be made and unmade at each marking. The arrangements being to dispense with the use of magnets, governing or giving, step by step, to the fabric, and also to dispense

Fig. 2.

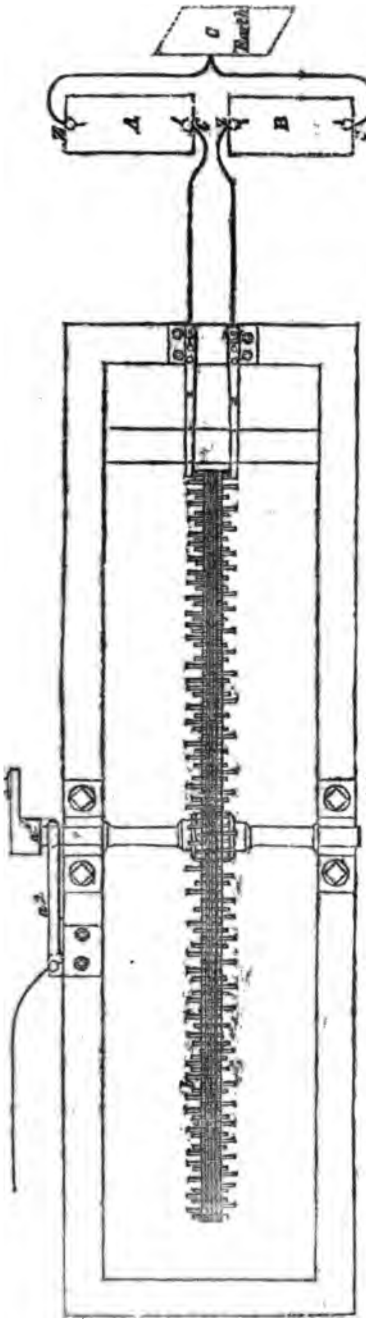
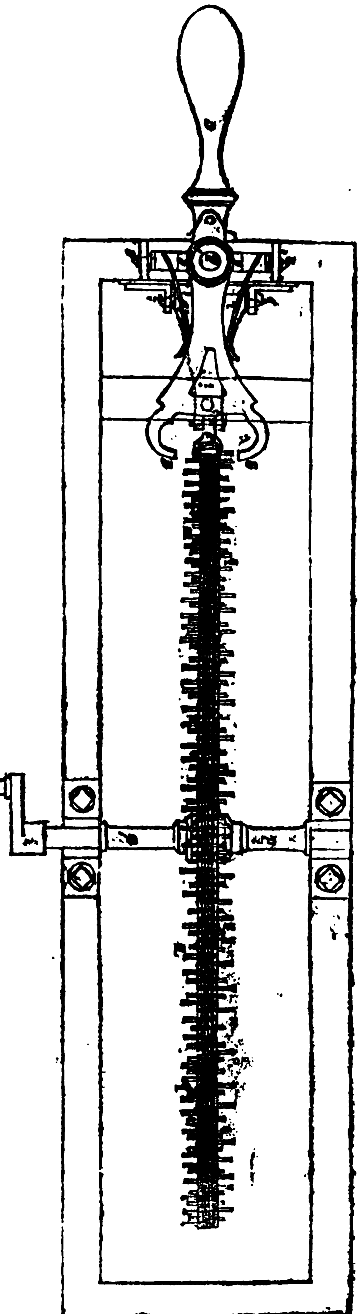


Fig. 3.



use of magnets for giving motion to the marking instruments, by which arrangement of apparatus and means the speed of electrical communications will be greatly improved and quickened; and the arrangement of the apparatus is also such that two distinct signs may be made through an electric circuit, according as the current is passed in one direction or the other, the electricity not passing through the chemically-prepared surface, but passing from and to one of two points pressing on the chemically-prepared surface near to each other, the mark being produced on the surface at the end of the metallic point, from which the electric current passes to the surface,—there being no mark produced where the other point receives the electric current.

* * * * *

Description of the Figures.

The nature of the apparatus employed, when composing a communication into a mechanical form, suitable for acting with other apparatus for transmitting the subject thereof to a chemically-prepared surface, may be greatly varied; and I propose to describe two arrangements for this purpose; at the same time I do not confine myself thereto.

Fig. 1 shows a side elevation of an apparatus for setting up a composed form. Fig. 2 is a plan thereof. This apparatus consists of a large circular plate, the diameter depending on the length of communications desired to be made. In the periphery of this plate *a* are numerous notches, into each of which is placed a short pin or wire *b*, the periphery of the plate *a* being grooved; the pins are retained securely in the notches by winding silk or thread round the plate, thus pressing on the pins, so as to retain them in any position to which they may be slided. The communication is composed by means of the handle *c*, which moves horizontally on the pin or axis *d*, which is fixed on the rocking-frame *e*, moving on necks or axes e^1, as shown. *f* is a stop, to prevent the handle descending too low on that side of the axes e^1: by this arrangement the handle *c* can move horizontally on its axis *d*, and vertically on the axes e^1. In the handle is fixed a forked instrument *g*, so that when the handle *c* is moved to the right or left as far as it will go, it will cause one of the pins *b* to be moved. *h h* are two springs, tending at all times to bring the forked instrument and its handle into a central position, and in this position the handle *c* is to be raised, by which means it will, by the projection c^1, act on the lever *i*, which moves on an axis at i^1, and is constantly borne upwards by a spring, as is shown, the other end of the lever having a driver *j* hinged to it, which driver, descending with the lever, brings the driver under another wire *b*, the stop *k* preventing the lever descending too low. The wires *b* are capable of being placed in three positions: first, in a central position; secondly, in a lateral position to the right hand; and, *thirdly*, a lateral position to the left hand; the wires *b* being neutral when in the central position, the wires acting differently by electric currents, according as they are pushed laterally to the right hand or to the left hand, as hereafter explained. In using this apparatus before composing a communication, all the wires are to be brought to a central position, and then the wires are to be moved to the right hand or the left, according to the succession in which they are to come into action, as hereafter explained, in making electric circuits; and it will be understood that whenever any wire, or succeeding wires *b*, are desired to remain in the central position, then the person composing the communication is simply to raise the handle, and thus to cause as many wires *b* to remain in the central position as the nature of the communication may require. The order in which the apparatus, or wires, are set for making a communication may be varied, but I have at No. 1* shown a convenient arrangement of signs for an alphabet, and other telegraphic signs which will be readily understood by examining the card No. I, at the same time keeping in mind that the two rows of marks are made by the pressing the wires to the right and left, whilst the spaces between the groups of marks are caused by omitting to move some of the wires to the right or to the left. The communication being arranged, the apparatus is to be lifted into the frame, fig. 3, where a similar apparatus is shown in plan, and the axis a^1 is to have an uniform rotation communicated to it by clockwork, by which those wires *b*, which are moved to the right hand, will come in contact with the spring (1), having a wire to a battery at A, and those wires *b* which have been pushed to the left hand, will come in contact with the spring (2), which also has a wire attached to the battery at B, and the two batteries are at their other ends in connection with a suitable conducting surface in the earth at C. The long telegraphic wire is in metallic connection by means of the brass spring a^2 with the axis of the transmitting apparatus at one end, and with the marking instrument hereafter described at the other end; and according to the position and grouping of these marks or lines, so will be the nature of the communication made. It will not be necessary to enter into a description of any

* The engraving of the card referred to will be given next week.

Fig. 6.

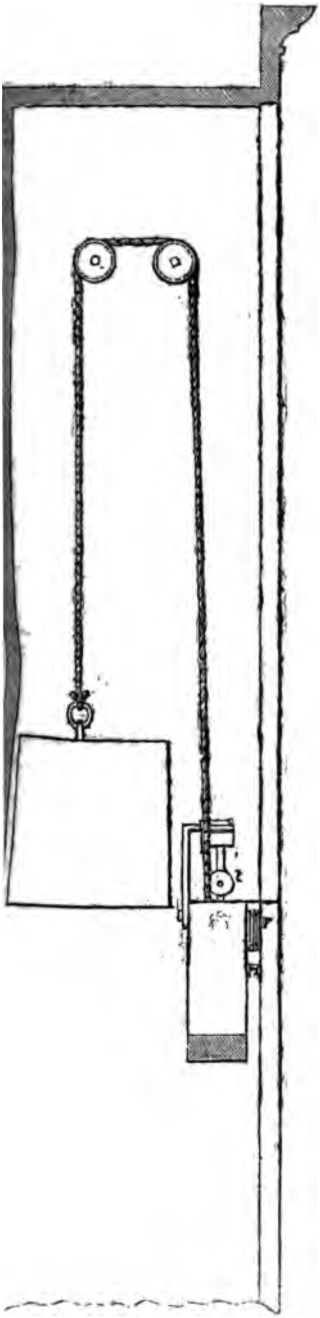
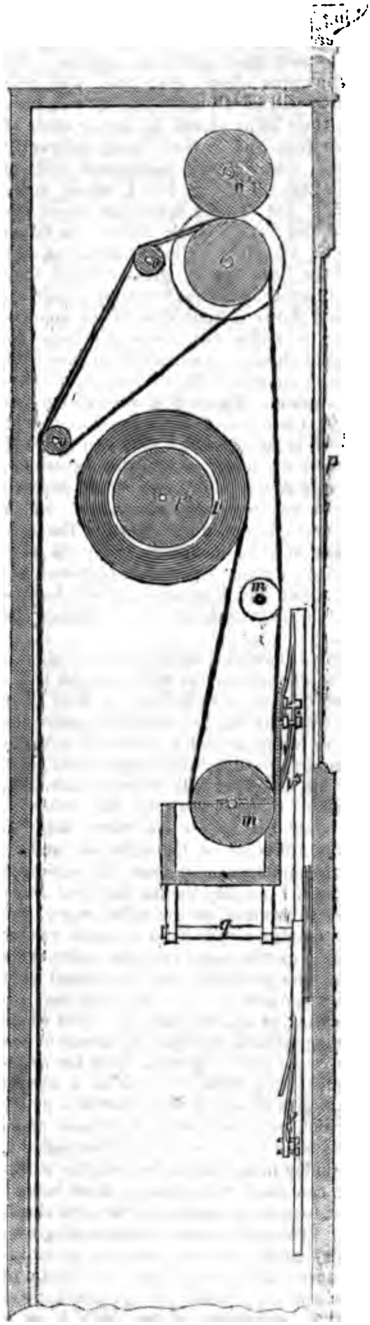


Fig. 5 .



particular arrangement of the marks for making a code of signals by such marks, as different persons will arrange them differently to suit their particular objects. By the apparatus above described, the dots or marks will be all alike, and it will only be by their being placed in one or other of the two lines, and by their being differently grouped, that different indications will be transmitted. The card No. 1, above mentioned, is not for the apparatus above described, but is applicable thereto, so far as where all the lines or marks are alike, but where the lines are of greater length they apply to other apparatus hereafter explained. Figure 4 shows a front view of the apparatus for receiving the communications by the aid of chemically prepared surfaces with the doors removed. Figure 5 shows a transverse section. Figure 6 is another section thereof; *l* is a roll of paper (on the cylinder l^1) which is the material I prefer to use, and I saturate the same, as hereafter explained, preferring to use a mixture of six parts of water to one part of sulphuric acid, which being first allowed to cool down to the temperature of the atmosphere, two parts of a saturated solution of prussiate of potass are to be added, and this solution is to be employed in such manner as to saturate the paper.

I would, however, state that other chemical preparations may be used, and the same, separately, are not claimed by me. The paper from the roll *l* is conducted under the roller *m*, which is partly immersed in a cistern containg the chemical preparation used, by which the paper will become saturated; the paper then passes over the roller *n*, down over the rollers *o o*, there being a pressing roller n^1 on the roller *n*; and in order to support and falicitate the motion of the paper, I employ elastic bands of India rubber in grooves on the rollers *n o o*, and I also employ a wide band of India rubber (as wide as the paper) on the rollers *m m* for the same purpose; there is a glazed front to the apparatus by which a person may see the passing paper, and read the signs which are being marked, or made, by means of the passage of electric currents from the apparatus above described, which is at a distant place. *q* is an axis having thereon a pulley q^1, which receives motion by means of an endless band put in motion by the pulley *r*, such pulley being driven by suitable clockwork, contained in the case *s*, there being a weight used for giving motion to such clockwork. The cord to the weight passing over a pulley on the axis of the roller *n*, moves the paper; and I prefer that the motion of the clockwork should be governed by a governor, consisting of two balls *t*, as is well understood. I have not tho necessary to show the wheel work clockwork, as the same is well undei and is not of my invention, and I only state in respect thereto, that il ranged to move the paper about a qu an inch during a quarter of a revolu the axis *q*. The axis *q* carries four a hard wood, each arm having two springs v v^1 one below the other spring v v^1 having a copper point or m which presses against the paper, a springs v v^1 at their other ends v^2 v to and press against the two fixed plates *w x*, which are separate and in from each other; they thus becon means of conducting the electric c from the transmitting apparatus abo scribed, in the manner hereafter exp to the surface of the paper. The re apparatus is to be kept in constant throughout the day by clockwork, as mentioned, there being paper introd sufficient length to occupy that len time in being unwound, and thus in a to a person being able to read a com cation (as it is being made) throu glazed front of the apparatus, a re all the communications made thro the day will be kept on the paper. springs v v^1 are so arranged in respect plates *w* and *x*, that as one pair leav tact with those plates the next pa come in contact therewith, and will p two lines of marks at a distance fr two previous lines of marks (that i posing electric currents are being tra ted, otherwise the paper will pass c remain plain), the lines of marks be curves produced by the marking point ing about their axis *q*, combined w right-line motion of the paper. The plate *w* is in connection with the lon graphic wire, and the plate *x* is put i nection with the earth at D, so as to abled to obtain an electric circuit b the distant place, where the trans apparatus is located, and the receiving ratus now under description. The quence of this arrangement will be when a wire *b* comes against the spri the circuit will be complete, and an e current will pass from the copper end battery through the spring (1), then t the apparatus, through the long teleg wire, through the curved plate *w* receiving apparatus, through the sprin to the point, or marker, in contact w paper, by which a mark will be made electric current will pass from the p the spring v^1 to the point of the sp and by the other end v^3 of the sprin the plate *x*, and then through the eart

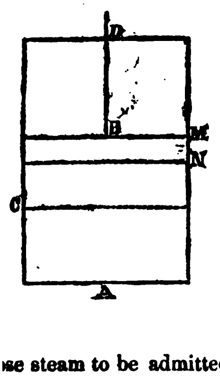
zinc end of the battery, as indicated; when the wires b come in contact with ring (2), the course of the electric t will be in the reverse direction, passing the copper end of the battery h the earth, then through the plate x, rough the spring v^3 v to the paper, through the spring v^1 v^2 to the plate through the long telegraphic wire to mitting apparatus, and from it the spring (2) to the zinc end of y.

s before stated that the transmitting s may be varied in its character and d such is the case in respect to the tion and nature of the mechanical which a communication may be prepared for being transmitted by electric currents to a distant apparatus, suitably arranged for receiving the communication on suitable chemically prepared surfaces, moved continuously by power during the time of making the communication; the points, or markers, constantly pressing against the prepared moving surface are continuously in a position to transmit the currents of electricity to mark the surface without the aid of electro, or other magnets, to cause a step by step movement to the chemically prepared surface, and also without the aid of any electro, or other magnet, to give motion to, or to govern the motion of, the marking instrument as has heretofore been considered necessary.

(*To be continued.*)

S ON THE USE OF MATHEMATICAL KNOWLEDGE TO ENGINEERS, AND HINTS TO THOSE WHO HAVE NOT THE BENEFIT OF A TUTOR.

(Continued from p. 8.)



se steam to be admitted into the AD at A until it occupies the C, the whole pressure on the t any instant being $=$ P pounds, a being of the same pressure as oiler from which it comes. If nce from A to C $=(a)$ feet, the *done*" through this extent of will be expressed by $P \times a$; and communication with the boiler pt open during the whole stroke iston the total amount of work moving the piston from A to D eing no pressure supposed on of the piston or any other resisthe force of the steam) would be D. But suppose the communiith the boiler to be cut off at C remainder of the stroke left to be accomplished by the expansion of the steam in AC. From this point therefore up to the top, we have a continually varying force which is not the same for any two positions of the piston or for any time however minute and inappreciable. It is obvious that we can no longer estimate the work done after leaving C in the same way as we did just now whilst the pressure remained the same from A to C. It is here that the Integral Calculus becomes absolutely necessary, and by considering the nature of the difficulty in the present case, a person who is ignorant of this part of mathematics, may form some notion of the invaluable aid it affords in all branches of physical inquiry. Indeed it may be safely asserted that the progress of Astronomy and all other parts of Experimental Science to which Mathematics are applicable is almost entirely dependent on this branch of it—and that without a thorough *understanding of its principles* (the Differential and Integral being here considered as the same subject) no student however expert he may be in "integrating" and performing algebraical tricks, can ever make any real progress in these inquiries. In making this observation I am deviating from the question before us, but I take this opportunity of assuring the learner that no time or labour should be grudged in obtaining a clear, downright, unmystified insight into this subject, as he may take it for granted that he can never by any

possibility do any thing without it. Let the distance from the bottom of the cylinder to $N=x$ and $NM=dx$. The pressure of steam being inversely as the space occupied we have the pressure on the piston at $N=P.\frac{a}{x}$. By the principles of the Differential Calculus we may suppose this pressure to remain unaltered whilst the piston moves from N to M: therefore on this supposition, the work done from N to $M=P.\frac{a}{x}.dx$. and the whole work done from C up to $D=\int P.\frac{a}{x}\,dx$. between the limits $x=AD=b$, suppose, and $x=a$.: and this integral or sum $=P.a(\log_\varepsilon b-\log_\varepsilon a)$. Now this expresses that the work done from C to D is equivalent to the *number of pounds* denoted by $Pa(\log_\varepsilon b-\log_\varepsilon a)$ raised *one* foot. For instance, let $P=1000$ lb. $(a)=$one foot and $(b)=10$ feet, then $Pa(.\log_\varepsilon b-\log_\varepsilon a)$ $=1000\times\log_\varepsilon 10=1000\times 2.3026=2302$. So that in this case the work done in expanding through 9 feet would be equivalent to 2302 pounds raised one foot (neglecting very small decimals).

As $Q_1\times S_1+Q_2\times S_2+$ &c., or in other terms to the sum of all the pressures or weights each multiplied by the space over which it has been moved. So that, if we like, we may say that the work done is P lbs. moved through $a(\log_\varepsilon b-\log_\varepsilon a)$ feet, or Pa pounds raised through $(\log_\varepsilon b-\log_\varepsilon a)$ feet, or lastly, as we took it at first, $Pa(\log_\varepsilon b-\log_\varepsilon a)$ pounds raised *one* foot.

If the integral $\int Pdx$ be considered in a somewhat different light, namely, as expressing the "sum of all the values of P between the given limits," the interpretation is still the same as before, inasmuch as the product $P\times S$ may just as well be considered to mean "the sum of all the pressures through space S" as the product of the number of units in P by the number of units in S;" *provided however*, that everywhere P be taken to denote the *instantaneous* pressure, *i.e.* that which does not last any finite time. In fact it is evident that the product of the pressure exerted by the *time* (or rather the product of the *units* in during which it is exerted, may just a be taken as the measure of the work as the product of the pressure and *sp* just as well, I say, except for c nience: as however in all actual ca the motion of machines, the spaces p over are much more convenient to sure than the time employed—(latter element indeed could seldo used at all for numberless reason choice of course falls on "space" r than on "time" as a more easily geable and measurable element. are cases however in which the would be preferable.

The "work done" if the stea not been cut off would have been 10 or 9000 lbs. raised one foot. So th loss of power due to this cutting $\frac{1}{10}$th of the stroke $=6698$ lbs rai foot. And of course in the sam any other question as to the effec duced by cutting off the steam a part of the stroke might be answ But as it may not be immediatel vious to some that the expression by integrating, really means wh have said, it may be as well to ente the reasons rather more fully. Su therefore the piston to move by succ starts from one position to anothe as from N to M, each of these succ spaces passed over being $=dx$, an pressures at the different stages denoted by P_1, P_2, P_3, &c. Ther viously, the whole "work done" i pressed by the sum,

$$P_1.dx+P_2dx+P_3.dx+\&c.$$

Now in estimating the "work d it matters not whether the whole sure or weight be raised at once th any given space or divided into rate portions each of which is or the resistance overcome thro certain space, *provided* the whole duct of the pressures by their resp spaces remain the same for both Thus if a weight Q be raised thro space S, and we take $Q_1\times S_1+Q$ $+Q_3\times S_3+\&c.=Q\times S$ the work will also be equal to Q_1 lb. raised S $+Q_2$ lbs. raised S_2 feet $+Q_3$ lbs. S_3 feet + &c. Hence the integ expression $Pa(\log_\varepsilon b-\log_\varepsilon a)$ bei reality the *sum* P_1dx+P_2dx+ & equivalent to such a series. The in which we have left equation (

the last paper, is not immediately applicable to our purpose—inasmuch as it involves *masses* and *accelerating forces*, whereas what we have given in actual cases are *weights* and *pressures*. The necessary transformation is easily made. Let W be the weight of the body whose mass we have denoted by (m), and so on for the others. Also let P be the *pressure* produced by the accelerating force X in this body. Then by the third law of motion, the pressures produced in the same mass are proportional to the accelerating forces corresponding to them; hence (g) being the accelerating force of gravity, we have

$$X : g :: P : W, \text{ or } X = g \cdot \frac{P}{W}.$$

Hence in such an expression as

$$mv^2 = m\int X dx$$

we may write instead,

$$\left(\frac{W}{g}\right)v^2 = \int P dx.$$

It is also easily shown that if P be the pressure produced by the three rectangular accelerating forces X, Y, Z, on the mass (m) and (ds) be the space through which (m) moves in the same time that (dx), (dy), (dz) are described along the axes, then $P ds = m(X.dx + Ydy + Zdz)$. So that the equation of Vis Viva for practical applications may be written

$$\left(\frac{W}{g}\right)v^2 + \left(\frac{W'}{g}\right)v'^2 + \left(\frac{W''}{g}\right)v''^2 + \&c.$$

$$= 2\int P ds + 2\int P' ds' + 2\int P'' ds'' + \&c.$$

The second side of this equation expresses the sum, or general amount of "work done" by each pressure. In every machine the whole of the pressures may be classed under three divisions; (1) the pressures at the part of the machine nearest the source of power, as the pressure on the piston of a steam-engine; (2) the resistance or pressures to be overcome, as the weight of the uplifted water in a pumping engine or the resistance at the crank and fly-wheel in rotary engines; (3) the various sorts of friction and other impediments to the transmission of the motion from one part of the machine to another.

So that the whole of the pressures operating on all the parts of the machine may be included and made to enter the equation of Vis Viva under the following form,

$$\Sigma(Pdp) - \Sigma.(Rdr) - \Sigma(Fdf).$$

the symbol Σ denotes as before the sum of all such terms as that to which it is prefixed, and which of course can only be actually written down at full length for each particular machine. Pdp represents the work done by the *useful* pressures, or those at the parts of the machine which *receive* the moving power in the first place, Rdr the work done by the various resistances, the very objects for which the machine is used, and Fdf is the work done in overcoming the *useless* resistances, such as friction. The negative sign is of course prefixed to these latter quantities because they are evidently *opposed* to the first.

The first side of the equation contains only quantities which are very easily measured, viz., weights and velocities: hence, if this first side be calculated for any given machine, and the first two terms on the second side be also calculated, the difference between the two results represents the *waste of power*, viz. that expressed by $\Sigma.\ (Fdf)$. or the force expended uselessly and without any return for it. Let us take, as an example, a pumping engine, where the resistance at the working end of the beam is always the same, and the work done by it is equal to the weight of water raised through a given space. Call this quantity W'', and the work done by the piston during the same time W', this being determined as in the case at the beginning of this article—taking care, of course, to allow for the weight of the atmosphere, &c., in the value assigned to P. If, also, the *useless* work done be called U, the second side of the equation of Vis Viva is $W' - W'' - U$. The velocity of the piston (supposed with its rod to move vertically as one body) being denoted by (v), that of the mass of water at the other end of the engine will also be (v). The only other moving part is the beam. If (ω) be the angular velocity of this at the same time as that to which all the above quantities are referred, the linear velocity of any particle of it at a distance (γ) from the centre $= \gamma.\omega$ and the sum of all the elements or particles each multiplied by the square of its velocity $= \Sigma.\ m.\ \gamma^2\ \omega^2 = \omega^2.\ Mk^2 Mk^2$ being the moment of inertia round the centre of the beam. The weight of the piston and its rod being Q lbs. that of the pump-rods Q′ and of the beam R, also neglecting

the weights of the air-pump rods, &c., and including their prejudicial resistances in the sum U, we have, as the equation

$$\frac{Q}{g} \cdot v^2 + \frac{R}{g} \cdot k^2 \cdot \omega^2 \cdot + \left(\frac{W+Q'}{g}\right) v^2 = W' - W'' - U.$$

Hence, if it is wished, U or the *waste of power* is known, since all the other quantities are known, and it is obvious that many other questions as to the velocities, &c., are also easily answered by a simple inspection of this formula. It

in this case (the weight of tl being W),

must be remembered that in it quantities are reckoned from a rest, or that the velocities are when the work done is nothin better, perhaps, to put the first the form,

$$\frac{Q}{g}(v^2 - v'^2) + \frac{R}{g} \cdot k^2 \cdot (\omega^2 - \omega'^2) + \frac{W+Q'}{g}(v^2 - v'^2).$$

v' and ω' being corresponding velocities at some other known time, and let the quantities on the second side denote the work done *since that time*.

In the common form of the steam engine, where the crank and fly-wheel are used, the connection between the various velocities is so much more complicated, and leads to such long and harassing calculations, that it is not at all a pleasant thing to enter upon; those wh to do so, however, may find so to suit them, and perhaps sa some labour, by referring to "cahier" of the *Journal de Polytechnique*, where there is laborious paper by M. Coriolis l'influence du moment d'inertie d cier d'une machine à vapeur, &c

(To be continued.)

GEOMETRY OF THE LINE AND PLANE.—BY T. S. DAVIES, F.R.S., L. & E., ROYAL MILITARY ACADEMY, WOOLWICH.

(Continued from p. 10.)

The NOTES, which form the present section of this course of geometry in some respects, have been more appropriately given at the end of the trea so early as is now done. It has appeared to me, however, that the needful c which a single volume affords to all such notes, would be destroyed if th not introduced thus early. The second and third (B) and (C) have b materially contracted, for reasons given in the opening of the former and of the latter. The next part of the series will be a commencement of the tl arranged in that which appears to the author to be *their natural order*.

Note A.

I do not recollect to have heard the objection which is stated in the text, this note refers, made by any geometer whose name ought to weigh with authority; but I have many times heard it from those whose official position fessional teachers, have conferred upon any of their dicta an authority to wh science gave them no title. It has generally been from mere draughtsme ideas of the true character of geometrical reasoning have been very imper whose notions respecting the functions really performed by the diagram in pl metry have been, to say the least, very confused.

But why should it be *unscientific* to employ an approximate representati objects of our contemplation, when they are of three dimensions, and yet s to employ them in the geometry of two dimensions? Why should we not sistent, and banish *all* representations from geometry, indiscriminately? W figures which do represent the objects in one, and that the simplest, branc subject, and refuse them in another and more complicated branch? Or w stitute in the difficult case that representation which, from its want of similari original, is calculated quite as much to mislead and embarrass, as it is to a conception; whilst, in the easiest cases of all, the complete representation is Only banish the model, and follow out its principle:—and geometry must b merely by means of general and indefinite terms! It becomes a language

and those signs themselves modified from their original import! Such an attempt was once made with respect to the first book of Euclid; and those "scientific" gentlemen will do well to make the experiment of teaching that book from the work in question, and at the same time submit the most gifted student so taught, to a comparison with one of the most humble talent who has been instructed in the ordinary manner. As a question of *efficiency*, this would be decided by such a test; as a question of *science*, it rests with them to explain the discrepancy between the use of accurate representations in plane and in solid geometry,—between the use of the diagram in the one case and of the model in the other. The scheme, in fact, answers no other purpose than *to throw difficulties into easy researches, and to confuse our conceptions of things which are in themselves clear and obvious.*

But one part of this sapient scheme consists in requiring the student to form a distinct idea *in his own mind* of the configurations of the object concerning which he is called to reason—to *imagine* all the points, lines, planes, curves, and curve-surfaces, ranged in their appropriate order, and subjected to their mutual relations. All this is to be done, too, without his having had the opportunity of seeing or handling any figure having the slightest likeness to the figure which he is to thus form! Have such teachers bewildered themselves with some confused notion of the doctrine of innate ideas and prototypes? Let me ask them whether they themselves acquired that modicum of the geometrical knowledge of figured space which they possess by such means? If they answer honestly, they will answer in the negative. They acquired their own facility in conceiving figures situated in space from the study of models—yet they deny their pupils the very means of which they (according to their own doctrine, surreptitiously) availed themselves! The judicious teacher will always try to enable his pupil to see a truth, or form a conception, as clearly as he himself does: the pedant, whose knowledge is always limited, finds it more convenient to throw all the mystery over his subject that vague language and impossible conditions can so easily effect. He thus answers two purposes:—he is not so soon exhausted of his little knowledge—the sponge is not so soon squeezed dry; and by dogmatically magnifying the difficulties of his subject, obtains a reputation for profound learning to which he is in no other way entitled.

That these persons should not perceive any "science" in the use of models, we can very readily believe; for they have used those models not for the purpose of scientific investigation, but for the mere verification of known or conjectural properties. Have they not generally done the same, too, with respect to the diagrams in plane geometry? Yet it no more follows that because a model *may be* used for the purposes of experiment that it shall be rejected for those of reasoning, than that the plane diagram should be rejected from plane geometry for the same cause. If they mistake a figure, plane or solid, used to reason from, for a mere experimental instrument, they have at least no right to debar us from the legitimate use of it for suggestive aid in rational processes. They, indeed, know nothing of reasons—they only know the mere fact, by having verified it in one or more cases; and could we see into the workings of their own minds, we should doubtless find the main evidence of the truths of plane geometry to be of the same character. If not, then their objections only become still the more absurd. Not having, indeed, *reasoned* from the model, they cannot comprehend how others should do it: but they may exercise the little semblance of modesty, by allowing that it may be possible for some men to do that which transcends even their own capacity. Ignorance, however, is always dogmatical; and the vague knowledge of the novice of matured age is viewed by them as the utmost limit of knowledge attainable by man!

There is, however, another, and a very different class of men, who object to the use of models; and I would address a remark or two to them. These men are geometers, often in the highest sense of the word.

The objection which they make is of this kind: that the student is thereby led to rest his conclusions *too much* upon the evidence afforded by models, and too little upon the reasonings; and that moreover it furnishes an excellent exercise in training the imagination, to dispense with their use.

To the first of these objections, I reply that the same holds good in plane geometry; and it is the business of the preceptor to take due precautions both in plane and

solid geometry, as in all other studies, to prevent boys from resting in the mere semblance of knowledge:—and students whose labour is voluntary should never rest satisfied without perceiving the logical conclusiveness of the entire argument.

To the second I reply, that these gentlemen forget that in learning to swim, they used corks or bladders, with which they *subsequently* dispensed. Would they refuse the use of the same means of learning to their sons? The use of models is *essential* to enable the student to obtain clear and definite views of figures situated in space: but he becomes more and more independent of them as he accustoms himself to the formation of those conceptions which they typify.

That the power of contemplating figures situated in space may be acquired so as *in a great degree* to enable us to dispense with the model, is undoubted: but it is a power that can only be acquired gradually and slowly, and never, or scarcely ever, without a free use of them in the earlier stages of study. In fact, some geometers have acquired this power—Chasles, for instance—to such a degree that they can carry on the most complicated discussions respecting figures in space without the aid of any figure but the ideal one which they form in their own minds. Still these geometers commenced their studies with their models before their eyes and in their hands—Chasles, with the splendid series formed under the direction of Hachette for the Polytechnic School; and by employing the same means, it is within the reach of any man of average capacity to attain the same power.

It may, finally, be remarked, that the construction of the projected diagram which represents the actual thing (or model) upon paper is often the most difficult part of the entire process of developing the investigation itself, so as to render the discussion intelligible to a reader. In so saying, I speak not from my own experience *alone*, but in accordance with the concurrent testimony of all those geometers who have devoted their especial attention to this class of researches.

Note B.

Much discussion has taken place amongst theoretical geometers as to the proper definition of an angle. The remarks in the editorial article which gave rise to the publication of these papers (*Mech. Mag. vol. xliv.*, *p.* 484) are so fully expressive of the difficulties with which Euclid's method of viewing this subject is encumbered, as to render it necessary to do little more than refer to it in this note.

In geometry it is found convenient to take the right angle as a standard, whether we regard the plane angle, the dihedral, or the solid. In trigonometrical researches and in the general application of algebra to geometry by means of these, the arc of the circle, whose centre is the angular point intercepted between the legs of the angle, is taken, *as a measure of the angle*, the standard-unit in this case being either one, two, or four quadrants. In analogy to this, the surface of the sphere concentric with a polyhedral angle and intercepted by the faces, has been very effectively employed as the measure of the polyhedral angle. It was incidentally suggested by Albert Girard; but it appears to not have attracted notice (though a subject intimately connected with it, the "*spherical excess*," was more fortunate) till it was revived by my venerated friend, the late Dr. Gregory. It was, indeed, only after its first publication in Hutton's Course, that he was made aware of the existence of the views of the Flemish geometer. Still this is only adapted to the algebraical (or trigonometrical) mode of treating polyhedral angles; and as it is *seldom* necessary to consider such angles in pure geometry, it is a question of little importance whether we can give it a form adapted to such researches as the present, or not. If any of my readers feel an interest in the subject, however, they will find the principles clearly laid down, either in the later editions of *Mr. Hind's Trigonometry*, or (rather more amply, perhaps) in the last edition of *Dr. Hutton's Course, vol. ii.*

The necessity for a standard measure of polyhedral angles in pure geometry, is an imaginary one. All our reasonings are carried on by proving the conditions which render two trihedral angles equal; and this is analogous to that by which the fundamental conditions of plane geometry are proved—viz., *superposition*.

It will be necessary to caution the student against bewildering himself with speculations founded on any other idea than that of *inclination*. A view has been growing up for some years on the Continent, which is not only extraneous to the first conception

of an angle, but which leads to results so remarkably contradictory, that one can only wonder that so obvious a fallacy should have found a place in the mind of a geometer. That view is—that an angle is the *space* intercepted between two lines, or between two planes; the former the plane angle, and the latter the dihedral—and the lines or planes produced *ad infinitum*. It seems to have originated with Bertrand of Geneva; but has been brought into an elementary course by one of the most influential and able teachers of geometry of the time,—M. Vincent, Professor of Geometry in the Royal College of Paris. This conundrum has greatly defaced the otherwise excellent treatise on geometry of this distinguished mathematician. He is not even startled with finding the application of his views he brings out the "spherical excess" only one half its true value!

Note C.

The construction of problems, in this department of geometry, is entirely hypothetical: the planes, and lines, or other figures, are merely *conceived to exist*, or to be so formed as to fulfil the enumerated conditions. Euclid, and nearly all geometers after him, adopted the principle, that no operation is to be assumed as possible, the mode of performing which has not been previously established, or else postulated as an elementary construction. Thus, he does not prescribe, even for the purpose of demonstrating a theorem, that a parallel or a perpendicular to a given line shall be drawn through a given point, till he has shown how that parallel or perpendicular can be drawn, and likewise proved that the line so drawn is parallel or perpendicular in the respective problems. It does not, however, appear that in a logical system, the reasoning would have been injured by a different procedure—and, indeed, in the eleventh and twelfth books of his "Elements," the principle has been, *in a great degree*, abandoned. For instance, the only problems given in Simson's edition of the eleventh book, are—

(1). To draw a line perpendicular to a plane, *props*. 11—12.

(2). To form a trihedral angle, *props*. 23—26.

(3). To construct a parallelopiped similar to another, *prop*. 28.

In the twelfth book there is not a single problem, and of the other books it is not necessary here to speak, since very few of the propositions contained in them possess the least interest to the class of geometers to whom the present work is addressed.

The few propositions just referred to in Euclid might have been dispensed with by a little alteration in the arrangement. Thus, when it is proved that there can always be one line, and only one, passing through a given point perpendicular to a plane, the existence of that line might surely be admitted, for the purposes of demonstration, without prescribing the means by which it may be drawn; and this without violating any principle of the most rigid logic. The existence of parallel planes, again, is assumed in the definition of them; why might it not be admitted that, through a given point, a plane may be constituted parallel to a given plane, without our previously showing how to draw that plane? The same argument applies equally in plane geometry as in solid; and, in fact, it is probable that modern practical geometry would have been benefitted by the adoption of such a view *in initio*. Had Euclid given no constructions, but merely shown that such lines or points as he found by construction could exist (and did exist singly) under the conditions of the proposition, and then assumed their existence in the case under consideration for aiding his ulterior reasonings, there would in such case never have arisen the common notion that Euclid's work was an imperfect and confused treatise on practical geometry. It is probable, too, that writers having in view the construction of problems, would have taken a very different route in developing their systems; as it is certain that by changing the route from that (in respect to *practical* geometry) accidentally selected by the illustrious author of the "Elements," a more effective practical course might have been produced. A slight sketch of such a course of practical geometry was attempted in the 12th edition of Dr. Hutton's "Mathematics," vol. i., a few years ago, by myself; and, whilst that is only a very incomplete development of the general view which I entertain, it will serve to render unquestionable the advantages that may be obtained by departing very widely from Euclid's order as to the arrangement

and construction of problems. Whoever, indeed, attempts to adopt Euclid's arrangements manifests a total misconception of Euclid's object; which was not to aid the draughtsman in making figures, but to assist the logician in determining their properties.*

The few *problems* of this class which require specification, will be inserted amongst the theorems, marked with letters instead of numbers. This is done rather to prevent vexatious cavils, than from any conviction of its logical necessity, or from any doubt of the validity of the preceding argument. At the time of writing the note at p. 8, it was my intention to class them together here; and they had been drawn up for that purpose.

NOTES ON THE DEMONSTRATION OF THE PARALLELOGRAM OF FORCES IN THE TRANSLATION OF POISSON'S MECHANICS.

(1.) In the translation of Poisson's Mechanics, page 38, vol. i., the solution of the parallelogram of forces is brought to the functional equation

$\phi x \phi z = \phi(x+z) + \phi(x-z)$ (1) and it is said, "This is the equation which must be resolved in order to obtain the expression ϕx." It is further remarked, "It is evident that it may be satisfied by assuming $\phi x = 2 \cos ax$, a being a constant arbitrary, so that we may have at the same time

$$\phi z = 2 \cos az$$

$$\phi(x+z) = 2 \cos a(x+z)$$

$\phi(x-z) = 2 \cos a(x-z)$: and in fact if these values be substituted in equation (1) there results the known equation

$$2 \cos ax \cos az = \cos a(x+z) + \cos a(x-z)."$$

Now, although this may be obvious enough it does not appear to be a *direct* solution of the above functional equation; a fortunate assumption is made, at least, as it seems to me, and all that follows in the demonstration depends upon it. The learned translator in his useful and copious notes has omitted to throw any additional light upon the subject. The following is in substance Poisson's solution of the equation as given in his work, edition of 1811:

From the equation $\phi x \phi z = \phi(x+z) + \phi(x-z)$ we have by expanding the second part of the equation by Taylor's Theorem and dividing both sides by ϕz,

$$\phi x = 2\left\{1 + \frac{d^2\phi z}{\phi z\, dz^2}\cdot\frac{x^2}{1.2} + \frac{d^4\phi z}{\phi z dz^4}\cdot\frac{x^4}{1.2.3.4} + \frac{d^6\phi z}{\phi z.dz^6}\frac{x^6}{1.2.3.4.5.6} + \&c.\right\} (2).$$

But x is independent of z

$$\therefore \frac{d^2\phi z}{\phi z dz^2} = \text{constant}$$

$$= c$$

$$\therefore \frac{d^2\phi z}{dz^2} = c.\phi z.$$

By successive differentiations

$$\frac{d^4\phi z}{dz^4} = c\frac{d^2\phi z}{dz^2} = c^2\phi z$$

$$\frac{d^6\phi z}{dz^6} = c^2\frac{d^2\phi z}{dz^2} = c^3\phi z$$

$$\&c. = \&c. = \&c.$$

* It has, indeed, been alleged that "Euclid's object in compiling the *Elements*, was *to construct the Platonic bodies*." The statement is apocryphal: it is, moreover, too absurd to deserve a moment's notice. What a singular waste of power, if such were the object! What a mass of irrelevant matter, if devoted solely to that end! The entire construction of these figures may be effected by considerations antecedent to the mere idea of ratio being formed, and only involving a few of the simpler properties of planes laid down in the eleventh book. This will be done hereafter, in the course of lessons now begun.

By substituting these values in equation (2),

$$\text{we get } \phi x = 2\left\{1 + \frac{c.x^2}{1.2} + \frac{c.^2x^4}{1.2.3.4} + \frac{c.^3x^6}{1.2.3.4.5.6} + \&c.\right\}$$

Put $c = -a^2$,

$$\text{then } \phi x = 2\left\{1 - \frac{a.^2x^2}{1.2} + \frac{a.^4x^4}{1.2.3.4} - \frac{a.^6x^6}{1.2.3.4.5.6} + \&c.\right\}$$

$$= 2 \cos ax$$

Similarly, $\phi z = 2 \cos az$.

Hence the nature of the function represented by ϕ is determined.

(2.) Abel, Œuvres, Tome Pre., Art, 1, has given a dissertation on functional equations somewhat similar to the above.

The late ingenious Mr. Thomas remarked upon this part of Abel's work, "That Laplace, in a note relating to the reduction of functions to tabular forms (*Journal de l'Ecole Polytechnique*) had investigated the nature of the function ϕ which shall satisfy the equation $xy = \phi$ (X + Y), where X is a function of x, and Y a function of y."

If we suppose $X = \psi x$ $Y = \psi y$ and $\phi(\psi z) = z$, so that ψ is a function inverse to ϕ, the equation will coincide with that deduced by Abel, page 4. Hence differentiating with respect to X,

$$\frac{ydx}{dX} = \phi'(X+Y)$$

differentiating with respect to Y,

$$\frac{xdy}{d.Y} = \phi'(X+Y)$$

$$\text{Hence } \frac{1}{x} \cdot \frac{dx}{dX} = \frac{1}{y}\frac{dy}{dY} = \text{constant, } q.$$

$$\therefore x = A\epsilon^{qX}\ ;\ y = B\epsilon^{qY}$$

$$\text{and } \phi\ (X+Y) = A\,B\epsilon^{q(X+Y)}$$

Poisson has shown that, if R be the resultant of two equal forces P, making an angle $2x$ with one another, we shall have $R = P\phi x$, the function ϕ being such as to satisfy the equation $\phi x\ \phi z = \phi\ (x+z) + \phi\ (x-z)$.

By differentiating twice successively with respect to x, and twice with respect to z, we get the equation

$$\frac{\phi z d^2\phi z}{dx^2} = \phi x \frac{d^2 z}{dz^2} \therefore \frac{1}{\phi x}\frac{d^2\phi x}{dx^2} = \text{constant} = k$$

$$\therefore \phi x = A\epsilon^{x\sqrt{k}} + B\epsilon^{-x\sqrt{k}}\ ;\ \text{similarly } \phi z = A\epsilon^{z\sqrt{k}} + B\epsilon^{-z\sqrt{k}}$$

$$\text{and } \phi x\ \phi z = A^2\epsilon^{(x+z)\sqrt{k}} + B^2\epsilon^{-(x+z)\sqrt{k}} + AB\epsilon^{(x-z)\sqrt{k}} + AB\epsilon^{-(x-z)\sqrt{k}}$$

$$= A\epsilon^{(x+z)\sqrt{k}} + B\epsilon^{-(x+z)\sqrt{k}} + A\epsilon^{(x-z)\sqrt{k}} + B\epsilon^{-(x-z)\sqrt{k}}.$$

Take $A = B = 1$

$$\text{then } \phi x = \epsilon^{x\sqrt{k}} + \epsilon^{-x\sqrt{k}},$$

which is the general solution of the equation.

If k be imaginary put $k = k'\sqrt{-1}$

$$\text{then } \phi x = \epsilon^{xk'\sqrt{-1}} + \epsilon^{-xk'\sqrt{-1}}$$

$$= 2 \cos k'x$$

The substitution of an imaginary quantity at the end of each mode of solution in order to obtain a trigonometrical expression, is perhaps remarkable. It is probable that the

translation of Poisson's celebrated performance will be read by the English student ference to the work in another language; moreover it is just possible that he may see the equation above discussed solved more generally, and by different methods events, under the impression that this may be the case, this article is sent to the *Mec Magazine.* J.

Exeter, July 2, 1847.

REPLY TO THE REV. THOMAS P. KIRKMAN'S REMARKS ON CERTAIN MATHEM. PRIZE QUESTIONS. BY W. S. B. WOOLHOUSE, ESQ.

The remarks of the Rev. T. P. Kirkman inserted at p. 604, last volume, on certain mathematical prize questions proposed in the Lady's and Gentleman's Diary for the years 1844, 1845, and 1846, would seem to require some reply; but in the observations I have to make, I am reluctantly compelled to be very brief.

Respecting the question proposed in the year 1845, of which Mr. Kirkman has furnished you with his ingenious and correct solution, and more especially the note addressed to me on the subject, I can only assure him that it is quite impossible to reply by letter to the numerous applications of correspondents.* At the same time, though I concur with him in the particular exception he makes to the enunciation of the question, I cannot bring my mind to regard it as an error, or to attach to the circumstance that degree of importance which requires special notice; nor can I conceive him to have been under any danger from being placed on record as one of the maintainers of the proposition. Had the case been otherwise, a note would most assuredly have been inserted in the Diary.

When the value of A, the greatest angle of the triangle, becomes such that

$$\tan\frac{1}{2}A+\tan\frac{1}{2}B+\tan\frac{1}{2}C=2,$$

one of the eight circles of contact, resolves into a straight line which is a common exterior tangent to the three given circles, and the reciprocal of its infinite radius becomes therefore zero; and when the angle A is less or greater than the value so determined, this circle in the one case is wholly exterior to the three given circles—in the other it envelopes them, and, in common with another circle, touches them all interiorly. Having altered the direction of its curvature, the radius is of course to be estima negative; and Mr. Kirkman mı aware that this is commonly dc geometrical theorems appertaini circles. It is worthy of remark, the Diary is given Mr. Weddle's tion of the general problem for an circles, as proposed by Mr. Hearn *Mathematician*, and that the g theorem, which recognizes all r negative in the case of an odd nun internal contacts, is applicable te possible case, determining, as it d this simple manner, the algebrai of the radius of each individual ci

Mr. Kirkman is inclined to c the accuracy of the Diary solution question of 1846, and deduces f an absurd inference. In reply, be sufficient to point out that, i mating the whole vertical pressu has overlooked the effect of the ı friction of the spheres,

$$F=\frac{1}{3}W\tan\frac{1}{2}\theta,$$

which must evidently act as a comp in every direction excepting the n He should have stated

$$R_1=W+R\cos\theta+F\sin\theta,$$

which gives the proper value $\frac{4}{3}$

The solution suggested by him 609 is, for the reason stated, undou incorrect. It is, however, advanc him with a most worthy and comı able diffidence, and needs no aj beyond a mere acknowledgment.

The remarks on the question of do not require any notice.

In conclusion, I beg respectfu thank Mr. Kirkman for the inter has taken in these subjects, and to e a hope that I may continue to be fav with communications from him.

26, Cornhill, London,
July 1, 1847.

* Vide note inserted at the foot of page 40 of the Diary for 1843.

COCK'S PATENT SPRAY-PUMP.

four years or so have elapsed since ntion was first brought before the ind it may be now perhaps better re- ed for the ridicule of which it was e, than for any promise of utility offered. From the following state- wever, which is given by the *Min- nal*, of some experiments which le with it at Llanhiddel on the 21st the presence of a number of emi- and coal masters, it would appear r no means the visionary sort of ich it was originally supposed to statement is preceded by a very ount of the nature of the invention; oth:

Adcock, instead of employing nd pump-rods, with buckets, clacks, y pipes of cast-iron, to raise water in a solid state, avails himself of anical effects produced by a cur- ir—that is to say, he employs a cylinder, by which he condenses ric air in the ordinary way to the amount of pressure—say 3½ to essure per square inch. He then the air so condensed into a reser- chamber of cast-iron; and thence made of sheet zinc, to the bottom ine, and again to the top. There efore, three pipes to be considered, g together, and forming but one here is, at Lanhiddel, the *down- e*, or that through which the air m the reservoir, or chamber, to the of the mine; the *upcast pipe*, which the air, and the water carried is conveyed to the top of the pit; *bend pipe* at the bottom, which e two together. These pipes are thin sheet zinc, No. 14 gauge. ncast pipe is 16 ins. diameter, the 2 ins., and the bendpipe gradually from 16 ins. at the junction with cast pipe to 12 ins., where it unites upcast. In the upcast pipe, about rom the bottom of the bendpipe, an ingenious contrivance, by which s of the upcast pipe, about 6 ins. n be separated from the adjoining the same pipe, so as to leave a slit, , all round the pipes; and as these beneath the surface of the water in r mine, when opened, by a con- at the top of the pit, a body of ushes into the upcast pipe—meets nding current of air—is dispersed s, like drops of rain—and is car- extraordinary velocity above the e pit. A zinc chamber, called the surrounds the upcast pipe; and in a few feet above the latter, a zinc cone is suspended, with its apex downwards—the apex being so placed, as to be exactly in a line with the centre of the upcast pipe. Hence, the water coming up with so great a speed, strikes the cone, and is by it dispersed, or radiated, on all sides, against the receiver—the consequence of which is, the water falls down in a solid body, to be conveyed through the launder-box away in the usual manner; while the air, having lost its carrying power, by expanding into the larger space, flows off, unencumbered by water, from the open top of the receiver. The principle of the invention is, therefore, to raise the water from a pit by raining upwards; and we must again repeat that, at Llanhiddel, the effects are so surprising, it is somewhat difficult to find proper words to convey a correct notion of it to others. Our correspondent (or, indeed, we should say our representative) saw it raise from 1000 to 1200 gallons of water per minute.

"At the bottom of the receiver, there is a pipe, leading vertically downwards, to the extent of 5 feet, to convey the water, when in a solid state, from the receiver to the launder. The bottom part of that pipe is 9½ ins. diameter; and near its junction with the receiver, it expands, bell-mouthed upwards, from 9½ ins. diameter to 11½ ins.; yet the body of water is so great, that that pipe becomes so choked, that the water stands in the reservoir 4 ins. above its bell-mouth. Again, as stated in our last Journal, a culvert, 11½ ins. wide, and 8½ ins. deep, although with a rapid fall, is insufficient to carry the body away."

POOLE'S IMPROVEMENTS IN ELECTRO-TELEGRAPHY.

[Patentee, Mr. Moses Poole. Invention communicated from abroad. Patent dated 14th December, 1846; Specification enrolled 14th June, 1847.]

I. *Improvements in Supporting and in Soldering the Wires.*—According to the present system, strong posts, called "Stretching Posts," are set up at intervals to which the ends of lengths of wire are attached by the intervention of suitable stretching apparatus. In these intervals standards are erected, having tubes of pottery-ware or glass bolted to the top, through which the wires pass, and in which they are supported. The stretching posts are consequently exposed to great lateral strain, and the large metallic surface of the stretching apparatus is brought into contact with the wires by means of the film of moisture wherewith it is covered in wet weather; whence results a large proportion of the total loss of the electric fluid. To obviate these drawbacks it is proposed, in the present specification, to make fast the one end of the first length

of wire to the ground, but in such a manner as to prevent the escape of electric fluid by the interposition of a disconnecting link or other wire; the other end is attached to that of the succeeding length of wire, and so on; the last one having the unconnected end made fast in the ground in the same manner as the first. The wire is supported by posts throughout its entire length in either of the four following modes:—(1.) The wire, at the point of contact with the post, is wrapped round with cotton or hemp, coated with shellac or some other anhydrous and insulating substance, and then lodged in a saw cut in the post, and kept there by a piece of wood nailed over the cut. Or (2.) the wire is passed through an eye in the post and wedged in. Or (3.), pieces of wood are slowly baked for twenty-four hours and then placed in an iron cylinder from which the air is exhausted, and when the nearest possible approach to a vacuum is obtained, shellac or some other insulating substance is allowed to rush in and fill the pores of the wood, into which are screwed iron eyes or catches, which are then plugged or wedged into the post, and thus support the wire in a state of perfect insulation. Or (4.) the iron eye or catch, which supports the wire, is passed up into a bell-shaped vessel of earthenware, having inside strong ledges of the same material, upon which the arms of the eye or catch rest. The stretching apparatus is portable, and made to operate on the wire in the intervals between the posts. It consists of two cast-iron clamps furnished with grooves and screws to receive and hold the wire, and also with suitable drawing tackle. When the requisite degree of tension is produced by the clamps being brought together, the wire is looped and made fast in the ordinary manner.

II. *Improvements in the Indicator.*—The patentee states, that the indicators hitherto used are composed of alternate pieces of brass and ivory, having a spring pressing against them, which in practice is found to cause the ivory to become covered with particles of brass, whereby the insulation is destroyed: and further, that there are twenty-four points of metallic contact to attend to; whereas, he employs in his indicator but two. This new indicator is constructed in the following manner:—Between the dial, which is furnished with the necessary letters, characters, or signals, is a wooden wheel, or rather disc, keyed on to the axle of the indicator needle, so that the one turns the other. On the surface of this wheel are a series of small permanent magnets corresponding to the characters on the dial. Opposite the centre and periphery of the wheel is a small ar suspended to a spring resting at th against a metallic point. This spring is f ed with a cushion to prevent the ar coming into actual contact with the m It follows, from this arrangement when the indicator needle is moved (the wooden wheel rotating with it), the small magnets is brought oppo armature, and attracts it, whereby th graphic circuit is completed. On t ther rotation of the wheel, the passes round, and the vacant space b the two magnets, being opposite the ture, the galvanic circuit is broken. the axle is another small magnet, w poles opposite a spring furnished w armature, and resting against a m point in manner similarly before de Beneath the dial is a vertical axle ar ing a hammer, and carrying on its extremity a horizontal wheel with co portion of its circumference, whic into ratchet teeth in the back of the wheel. When the axle is caused to the hammer is brought a distance o one quarter of a circle from the bell for the present it remains stationary, backwards against a spring lever, wh a small piece of nickel at the oth placed opposite to two other pieces o covered with wire and silk. The pieces of nickel are rendered m through the medium of the small and accompanying arrangements bef scribed, when they consequently att opposite piece of nickel, whereby th end of the spring lever is pressed the hammer, forcing it to descend bell. The hammer is prevented fro ing on the bell, after concussion, by s suitably adjusted.

III. *Improvements in the Commu*—The chief improvement in the co cator is the combination of the two s at present in use. In the face of th ratus is a logitudinal slit, behind whic axle, having 24 radial arms arranged on its periphery. At the extremity of these arms is a small disc with t racter or letter painted thereon. axle rotates, each of the characters cessively presented to the observer, de and distinctly, each letter invariabl pying the same position; that is to is always the first to the left, and Z, the last to the right.

IV. *Improved Driving Machinery* consists in an upright spring slip of vibrating on a pivot. At the top of are three arms, two of which act oscillation of the slip so as to c revolve a toothed wheel fixed to the

, while the third, or centre one, is ructed as to prevent more than one ssing at a time.

fiscellaneous Improvements. — The proposes among various other im- nts, not to draw the iron wire holes, but between two rollers, that wire so produced is less brittle, r adapted for electro-magnetic pur- To substitute zinc and lead wire er in the conveyance of signals tances.—To employ nickel instead on for magnets.—To make steel out of two steel blades held together m, or of three blades in the form sides of a parallelogram.—Or to rse-shoe magnets out of sheet And, lastly, to keep a perfect f all communications, by placing d attaching to each key a point, n the key being pressed down, piece of paper wound on and over portion of the paper being wound h successive prick.

RAILWAY BUFFERS.

In your number of June 26th, ge Cayley has given a plan for tyles a "locked" buffer. With rence to Sir George, I cannot king he has taken but a partial s practical operation, the action ffers being always in a direct with the other, and not subject viation. I therefore beg leave the following: What would be upon the rods when one buffer three or four inches higher or n the other, and, consequently, ing within the cylindrical box? e this, with the blows from the would soon prevent the *free* of the rods.

latter part of his letter, Sir Cayley touches the right chord. tre is indisputably the proper the forces to act upon. *Side* re manifestly wrong; and the the buffer-springs in the gene- ng no doubt tends to promote l agitation which is so bad for and carriages. If the ends of gs could be *equally* pressed upon ne time, they might very much his lateral oscillation, which now alternate pressure upon the irst against one end, and then ,—one carriage acting conse- as a pendulum to the next, and ough the whole train.

With respect to "Cymro," in your last number, he appears somewhat a monopolist. I cannot see that his design has any claim to analogy with Sir George Cayley's plan, which appears to be original. He mentions his concave and convex buffers in off-hand style; but I cannot look upon them as capable of removing the "cause of apprehension and danger." The present erroneous method is altogether too incompetent to be remedied by mere alteration in the form of buffers.

There would be no difficulty in showing that far superior methods may be applied, if there were facilities and encouragement afforded for doing so; but there are evidently those who can do as they like with the matter, and seem determined to keep the problem in their own nursery.

Directors must express their determination to have better securities provided, and throw the solution of the problem freely open to all; then they would, no doubt, soon have some method more capable than the present, which seems to be persisted in solely from a weak prejudice—"that nothing better can be done."

I am, Sir, yours, &c.,

G. M.

Birmingham, July 5th, 1847.

ON LOCKED BUFFERS.

Sir,—You published a letter, on the 26th June, from Sir George Cayley, suggesting the adoption of locked buffers. Last week you also published one from "Cymro," claiming priority of the idea. May I, through your kindness, refer "Cymro" to the *Sun* evening paper of June 26th, 1845, where he will find a long article about locked buffers, and many other improvements relating to railways, which I think would not be out of time or place were they to see the light again through the medium of your widely-circulated magazine. It is somewhat curious that the very commission there suggested should be now adopted. I hope it will be for good; for railways, as at present constructed, are not safe—but until we have a royal accident, the people cannot expect the least alteration or improvement.

I am, Mr. Editor, yours respectfully,
and, I believe, as old a reader and
subscriber as you have living,

JOHN SUTTON.

42, Stamford-street, Blackfriars-road,
July 6, 1847.

P.S. I have but one printed copy left, else

I would forward you one; and it is too long to write out upon a doubt of its being inserted. You must be aware, Mr. Editor, of the immense mass of labour there is thrown away in this way; but if I thought it would be inserted, I would send it.

[We can only say, that if we think the letter deserving of republication, we shall have pleasure in giving it a place in our columns. But we cannot be expected to make any promise on the subject till we do see it in one shape or other. If Mr. Sutton will send us his printed copy, it shall be safely returned to him. Ed. M. M.]

LIGHTING BY ELECTRICITY, SIGNAL-LAMPS, &c.—STAITE'S PATENTS.

Sir,—Referring to your notice last Saturday week of my improvements in lighting by electricity, and their application to signals on railways and other purposes, I have to observe, that though, in general, your account is sufficiently explanatory of the ends I have laboured so long to accomplish, you are by no means correct in your description either of the apparatus employed, or the mode of employing it. My object in writing this letter (and which, in justice to myself, I respectfully request you to insert in your next number) is, that your readers and the public may not be led to suppose that I am responsible for anything you have been pleased (in your ardour for science, and your anxiety to keep the public informed of all that is doing) to describe and publish as my invention,—as in many respects your descriptions are not only defective, but incorrect. For reasons it is not necessary to enter upon here, I shall for the present abstain from any explanation of my matured plans; but to this I pledge myself,—that at an early day (as soon as my arrangements and apparatus are completed) I shall exhibit to the public a perfect and permanent light, of any required power and intensity, suitable for all purposes of lighting,—private dwellings, shops, churches, or streets; and which shall not only be the best and purest light ever seen, but *the cheapest*. So much for my permanent light.

With regard to the applications I am engaged upon, both in reference to *permanent* and *intermittent* electric light, I may say that, ere long, I shall be in a condition to submit to railway companies especially, a system, both as respects stations and running trains, which will effectually accomplish perfect and instant communication between stations and trains, and also between guards and passengers, and guards and engine-drivers,—a system which, if adopted, will render accidents on railways as rare as they are now the reverse. I have devote years of anxious study to the subject tric lighting, and experimented more lieve, than any other man, with a render it useful for practical pu Whether I have succeeded or not in the difficult problem, the public w long, have an opportunity of decidin

I am, Sir, yours, &c.,

W. E. St

London, July 5th, 1847.

[No one could suppose Mr. Stait "responsible for anything" stated b specting his invention. Though per would not be wronged were the de description of which he complains ascribed to the meagreness and obsc his own explanations. We are cons his animadversions by his admissi our account was, after all, "suf explanatory" of the ends which he is ing to accomplish. Ed. M. M.]

MR. ABATE'S SEWER TRAP.

Sir,—To Mr. Hale's objection ag hydrostatic valve, related in the last of your journal, I oppose the fact, *ball floats*, which every body ma directly, by trying the model at the of Arts, and in a few weeks hence experiments of the valve in full siz sewers in London, which have been ordered by the commissioners of But this fact lies in the very same law through which Mr. Hale him deavoured to demonstrate the opposi depending on the particular condi the apparatus. I will explain thi pose a ball, of specific gravity little l water, placed in the bottom of a r opened by a circular hole, of a d little less than that of the ball, and t pient containing water which covers t it is evident that the ball will not fl cause the pressure it receives from t above is greater than that below; th case of Mr. Hale. But suppose, on t hand, a ball of specific gravity m than water, placed in the bottom o pient open with a circular hole, of ter the half of the ball; if water co this recipient, before it can rise to th of the middle of the ball, the ball w being pushed upwards only by th which acts on a spherical zone surr the portion which covers the hole my case.

After this, I am not astonished Hale's assertion that, through the perience he has of sewers, he is p that the best way to prevent the e effluvia from them is his own pate

because everybody thinks well of his own invention, and endeavours to bring water to his own mill; but no one being able to be *judex in causa propria*, it is right to leave this judgment to the public, to whom it belongs.

I expect from your impartiality and good faith, the insertion of the present in your journal; and I am quite sure that you will be glad to ascertain for yourself and the public, that the Society of Arts, with which are connected so many scientific and practical engineers, was not so blind as to grant the prize of competition for a foolish invention.

I am, Sir, yours, &c.,
F. ABATE.

28, Cold Bath-square,
July 3, 1847.

ABATE'S SEWER TRAP.

Sir,—In consequence of "E. B.'s" suggestion in your last Magazine, I went to the Society's house in the Adelphi, and saw Abate's sewer-trap, and when I inform you of the dimensions of its several parts, you will not be surprised that it bore satisfactorily the "severe tests and experiments before the committee." The model deposited by Mr. Abate is a small glass vessel, the hole in the bottom appearing to me to be 2 ins. diameter, the ball 5½ ins., and the vessel nearly double the diameter of the ball. Now, it is very evident that in a machine like this, the proportions of its parts may be such, that the force of the buoyancy of the ball upwards shall be greater than the pressure on the hole, and, consequently, the ball will rise. "E. B." is therefore quite correct in supposing that the efficiency of the machine "depends upon the proper proportions of the various parts," but the observance of these "proper proportions" would render the apparatus inapplicable to public sewers; for instance, the gully-holes in the City are equivalent to apertures of 20 ins., some 30 ins., and many 40 ins., diameter. Let us suppose it were determined to use one of Abate's traps constructed with its "proper proportions" in a gully-hole of 20 ins. diameter, the ball to cover this hole must be 4 ft. 7 ins, and the brick vault about 9 feet diameter! In the apparatus I made, which failed, the diameters of the hole, the ball, and the vessel, were in the proportions of 9, 12, and 18, respectively.

The person in attendance at the Society's house said to me in reference to the model, "Mr. Abate has tried no other sized trap than this; he told me so, nor has the Society." Many would no doubt perceive, at first sight, that unless the material (whether it were a sphere or a plane) projected far beyond the hole it could not rise. In old works on mechanics we find, "How to make light wood lie at the bottom of water;" and one method described is by making a hole in the bottom of a vessel, and making the wood lie air-tight over the hole, when on filling the vessel with water, the wood will remain in its place.

I hope these observations will serve to remove the apparent contradictions in the letters of myself and "E.B.," for it is not without good evidence that I would venture to speak lightly of a man's invention in such an influential journal as the *Mechanics' Magazine*.

I am, Sir, yours, &c.,
J. L. HALE.

8, Well-street, Hackney,
July 6, 1847.

PATENT LAW CASES.

DEFECTIVE SPECIFICATIONS.

Court of Common Pleas, Guildhall, July 1.

(Before LORD CHIEF JUSTICE WILDE and a Special Jury.)

CROLL V. EDGE.

This was an action to recover damages for the alleged infringement of a patent dated 16th March, 1843, for "improvements in the manufacture of gas for the purposes of illumination, and in apparatus used when transmitting and measuring gas or other fluids." An objection was taken on the part of the defendant, that the specification and claim which had been enrolled were larger than the patent. The specification claimed for the patentee, amongst other things, a mode of making clay retorts in moulds for making gas. It was, therefore, contended that this was more than the patent extended to; for, that the mode of manufacturing retorts was one thing, and the mode of manufacturing gas with the help of such retorts, another, and a very different thing.

His LORDSHIP being also of this opinion, a verdict was found for the defendant on the issues raising this objection, leave being given to the plaintiff to move to enter a verdict thereon for him; and the jury were discharged from finding on the other issues.

BEARD V. EGERTON AND OTHERS.

This was an action brought for the infringement of the patent for Daguerreotype, taken out in this country by Mr. Berry, and of which the plaintiff became assignee.

The invention called Daguerreotype is well known as a means of producing pictures and likenesses by the action of light; and it appeared, from the evidence given on the part of the plaintiff, that in the preparation of the plates, before putting them into the camera obscura, it is essential they should be exposed to the vapours of iodine, in order to produce the sensitive coating. If iodine, however, is only used, the image from which the representation is taken, must be stationary, and the process is, besides, very slow; and it has since been found a great improvement to use iodine with chlorine or bromine, as it considerably increases the sensitiveness of the coating, and accelerates the process of taking the likeness. In the specification of the patent the use of iodine only is pointed out.

At the close of the plaintiff's case,

Mr. WATSON took several objections, the princi-

pal of which was, that the specification was inaccurate. The patentee had stated various stages in the process, and had accordingly divided the specification into various separate parts. In the first of these parts acid was stated as proper to be used for the cleaning of the plates, and towards the end of that first part the following paragraph occurs:—"When the plate is not intended for immediate use or operation, the acid may be used only twice upon its surface after being exposed to heat. The first part of the operation may be done at any time This will allow of a number of plates being kept prepared up to the last slight operation. It is, however, considered indispensable that just before the moment of using the plates in the camera, or the reproducing the designs, to put *at least once more* some acid on the plate, and to rub it lightly with pounce, as before stated; finally, the plate must be cleaned with cotton from all pounce-dust that may be on the surface, or its edges." The evidence showed, and indeed it was admitted, that if the acid or rubbing were applied *after* the plates had received the iodine, it would entirely destroy their efficacy; and therefore it was contended the specification was bad, as a party could not follow out this part of the specification as described. On the other side, it was contended that no ordinary person could be misled by the specification; as the only object of the first part was to get the plates ready for the second part of the process, which related to the exposing of the plates to the operation of iodine, it could not be supposed that the acid was to be applied after the iodine had been used.

His LORDSHIP, however, was of opinion that the specification was in this respect, to say the least, ambiguous. The public were not to be compelled to read the whole of the specification, and then to reason on the whole, when so read together. Here it was stated the acid should be used just before the moment of reproducing the designs. The time was pointed out so distinctly and emphatically, that the specification was calculated to mislead, although probably it was not so intended. Still, if it left the matter in any doubt, it was equally objectionable.

Mr. WATSON then submitted that the use of chlorine and bromine in conjunction with iodine was not an infringement of the patent; but

His LORDSHIP held otherwise.

Upon which Mr. Watson declined addressing the jury;

And a verdict was then taken for the plaintiff on all the issues except the one raising the above objection to the specification, and on that the verdict was entered for the defendants, leave being given to the plaintiff to move thereon before the Court next term.

THE VASSITEI TIDJARET.—MEANS OF COMMERCE.

The above is the name of a vessel belonging to a company at Constantinople, of which the sultan is the head, which has been just built on the Thames. She made an experimental trip down the river on Wednesday, with a large and very distinguished party, amongst whom were His Excellency Prince Callimaki, the Turkish Ambassador, and the Princess Callimaki, Sir Stratford and Lady Canning, Sir Jasper Atkinson, Mr. Izohrab, the Turkish Consul, &c. The vessel left the pier at Blackwall at 12 o'clock, and proceeded down the river, but owing to the low state of the tide, she could not be put at her full speed till she had passed through Barking Reach. She afterwards steamed to within two miles of the Nore Light, where she arrived at 31 minutes past two; after which, she came back to Blackwall, which she reached at 12 mim five o'clock. The vessel was built by M and J. White, of Cowes, the celebrate builders, and is 200 feet long on deck, 31 fe beam, 19 feet deep, and of nearly 10(builders' measurement. The engines we by Messrs. Maudslay, Sons, and Field, double cylinder principle, with tubular boil are of the nominal collective power of 30(The speed of the vessel was ascertained on trial, as well as on Wednesday, to be a little statute miles an hour through the water; considering she had 100 tons of coal, 10 water, all her chains, anchors, stores, & boats on board; that she was fully rigged, her yards aloft, and drew 13 feet water, is extraordinary speed. She has excellent ac tion for passengers, and stowage for 400 goods. Her station is to be between Co nople and Trebizond.

SOUTH WESTERN STEAM NAVIGA COMPANY.

A new iron vessel called the *Express*, i for the Havre and Southampton station, Messrs. Ditchburn and Mare, and fitted gines by Messrs. Maudslay, Sons, and Fi tried down the river on Tuesday, and sl from alongside the Nore Light to the rail minus at Blackwall, a distance of 47 mile hours and eight minutes, which is, we beli shortest time in which the same distance accomplished.

LIST OF ENGLISH PATENTS GRANT JULY 3, 1847.

Joseph Browne Wilks, of Chesterfield I sex, Esq., for improvements in the manuf oil from certain nuts from which oil has before manufactured, and producing a substance, and the application thereof for pose of affording light and other uses. Ju months.

Eliza Tonge, of Boston, Lincoln, for i ments in ornamenting glass. July 3; six

Robert Weare, of Argyle-street, Birl watch and clock maker, for improvements i or timekeepers. July 3; six months.

Alexander Mitchell, of Brickfields, Bal rell, Ireland, civil engineer, for an extensi ters patent granted to him by his late Maje William the Fourth, dated the 4th day of the fourth year of his reign, for the full te years from the 4th of July, 1847, for his inv a dock of improved construction to facilitat pairing, building, or retaining of ships a floating vessels, and that certain parts emp the construction of the said dock of his i are also applicable to other purposes. Ju months.

George Alexander Miller, of Piccadilly, sex, for improvements in lamps. July months.

George Augustus Huddars, of Brynker, von, Esq., for certain improved apparatu cultivation of land. July 3; six months.

John Hunt, of Birmingham, brass-fou a certain improvement, or certain impro in effecting the combustion of gas, oil, cam other substances, which are, or may be b the production of light. July 3; six mon

Jeremiah Brown, of Kingswinford, Staf turner, for certain improvements in rolls

chinery used in the manufacture of iron, also in rolls and machinery for shaping or fashioning iron for various purposes. July 3; six months.

John Ray, of Albion-terrace, Commercial-road East, for improvements in constructing or fitting the interior parts of ships or other vessels, warehouses, and other depôts, for the purpose of facilitating the delivering or removing from ships, vessels, warehouses, and other depôts, of the cargoes or contents thereof. July 3; six months.

William Edwards Staite, of Lombard-street, gentleman, for certain improvements in lighting, and in the apparatus or apparatuses connected therewith. July 3; six months.

Theodore Claeys, of Ostend, Belgium, and Louis François Strand, gentleman, of the same place, for improvements in the manufacture of various articles from cork. July 3; six months.

John Carr, of Blackburn, Lancaster, for certain improvements in looms for weaving. July 3; six months.

George Winslow, of Boston, Massachusetts, U. S., for improvements in machinery for manufacturing files and rasps. (Being a communication.) July 3; six months.

Edmund Wheeler, of Basingstoke, Hampshire, ironmonger, for improvements in valves for steam and other engines. (Being a communication.) July 3; six months.

LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED UNDER 6 AND 7 VIC. CAP. 65

Date of Registration.	No. in the Register.	Proprietors' Names.	Address.	Subject of Design.
July 2	1116	Frederick Ayckbourn,	Palace New-road	Life-preserver and swimming-belt.
3	1117	Edward Colsell Rose	Northfleet, Kent	Circular domestic telegraph.
„	1118	Alexander Austin, Thomas White, and Henry Francis	Pleydell-street, Fleet-street	Envelope.
5	1119	John Bartlett and Son,	Welch Back, Bristol	Spring sugar-mill.
„	1120	Francis Baildon Oerton,	Walsall	Shaft bearer and buckle.
6	1121	William Hunt & Sons,	Brade's Steel Works, near Birmingham	Draining tool.
„	1122	John Jones	London-wall	Washing machine.
„	1123	Charles Phillips	Atherstone	Hat ventilator.
7	1124	James Dredge	Bath, civil engineer	Balanced bracket girder for bridges, viaducts, &c.
8	1125	Harrild and Sons	22, Friday-street, Cheapside	Bookbinders' plough.

Advertisements.

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LONDON: Edited, Printed, and Publi[...] Joseph Clinton Robertson, of No. 16[...] street, in the City of London.—Sold [...] W. Galignani, Rue Vivienne, Paris; M[...] Co., Dublin; W. C. Campbell and Co., H[...]

Mechanics' Magazine,

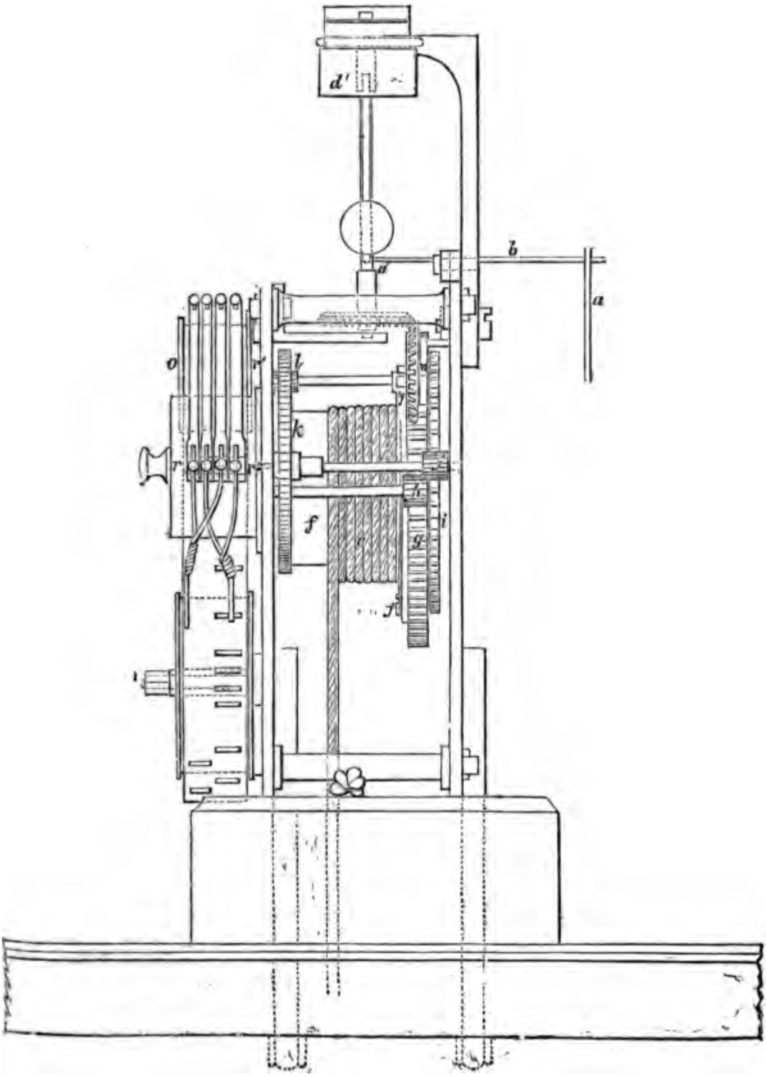
MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 1249.] SATURDAY, JULY 17. **[Price 3d.**

Edited by J. C. Robertson, 166 Fleet-street.

BAIN'S NEW SYSTEM OF ELECTRO-TELEGRAPHIC COMMUNICATION.

Fig. 10.



MR. BAIN'S NEW SYSTEM OF ELECTRO-TELEGRAPHIC COMMUNICATI(

(Continued from p. 31.)

Second Arrangement.

I will now describe another arrangement of apparatus for transmitting and receiving communications by electrical means, such apparatus being arranged for transmitting and receiving communications at intervals, the apparatus both for transmitting and for receiving remaining quiet when not required for transmitting a communication.

The apparatus is, however, so arranged that, when in work, mechanically composed communications may be transmitted with far greater rapidity than by any other arrangement, or system, of electrical telegraphic communication heretofore used, or proposed, owing to the circumstance of dispensing with the use of magnets, and having continuous motion, both in respect to the mechanical composed form, and also in respect to the receiving surface, and also in respect to the marking instrument.

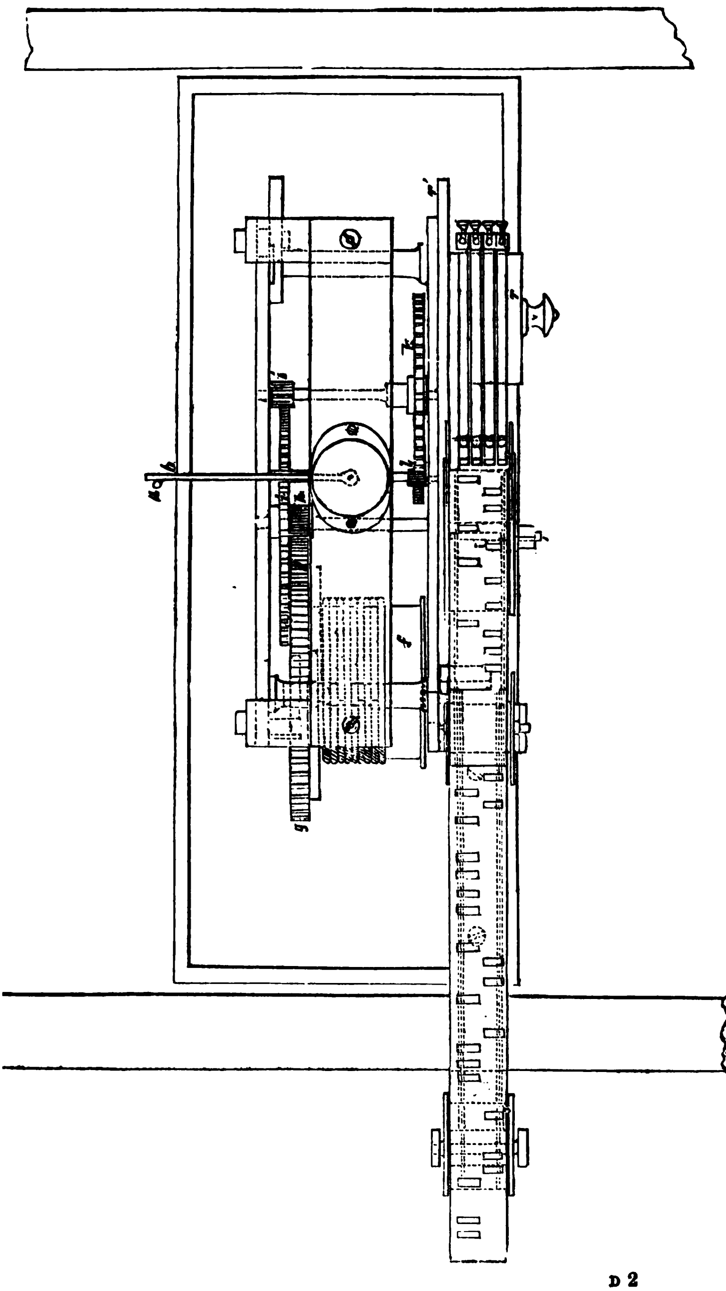
The apparatus according to my invention dispensing with the step by step motion consequent on the use of magnets heretofore employed, either for giving or governing the motion of the receiving surface as in Davy's, and also in my former apparatus, or for giving or governing the motion of the marking instrument, as in Morse's apparatus before mentioned. Fig. 7 is a side view, and fig. 8 shows a plan of an apparatus for transmitting and receiving communications by electric means.

Fig. 9 shows a plan; fig. 10 is an end elevation; and fig. 11 is a front view of the apparatus.

Fig. 12 showing two distant apparatus (connected by a long telegraphic wire) such as are used for transmitting, and also for receiving communications; the apparatus at each end being such as to be used either for transmitting or receiving a communication; and I recommend that the apparatus at both ends, or at the two distant places, should at all times be in a condition to receive a communication, and if the party attending to either of the apparatus be desirous of making a communication, then to remove the prepared paper, and to introduce the mechanically composed form of the communication he desires to transmit, the present apparatus being used to transmit a communication from paper, and to receive it on chemically prepared paper; hence the same instruments are applicable at both ends, and the apparatus at each end, when at work, is to be kept in motion at corresponding rates by mechanical means: I prefer to do so by clockwork, such as is shown, by which arrangement the mechanically pre]
having the communication, will
continuously during the transm
communication therefrom, at
speed, or as nearly so as may be
the chemically prepared surface a
end of the apparatus, at a dist
The apparatus shown at figs. 7
11, and 12, are suitable for bei
by one telegraphic wire, using t]
the means of completing the ci
now well understood. I will su
the communication is to be mad
apparatus marked London, and
the apparatus marked Edinbu
apparatus is so arranged as to b(
stop, or detent, which may be m(
the way by means of an electri
put in motion by the person n
communication; as is well under
now commonly practised, when
detent or stop, for allowing an
get into motion.

The consequence of removing a
or stop *a*, out of the way of th(
each apparatus, will be, that the
the weight *c* of each apparatus
longer restrained, and will begin t
and the wheel-work of each app
be simultaneously put in motion
remain in motion so long as th
out of the way of the arm *b*, the
affixed on the axis *d*, moves rou
Motion is communicated from th
by means of the cord *e*, which is
the barrel *f*, on the axis of which is
cog-wheel *g*, the catches f^1 takin
ratchet-wheel fixed on the barr
the barrel and the cog-wheel *g* tog
allow of its being turned to wi
cord, the cog-wheel *g* takes
drives the pinion *h*, on the axis of
fixed the cog-wheel *i*, which take
drives the pinion *j*, on the axis of
fixed the cog-wheel *k*, which take
drives the pinion *l*, on the axis of
fixed the bevelled tooth wheel *m*, wl
into and drives the bevelled toothed
which is on the axis *d* of the
which is similar to what has hereto
used; the expanding arms of the g
balls being adjusted or controlled l
or lowering the external tube *d*
which the upper parts of the arms
The paper, whether it be the cl
prepared paper, or the one having
chanically composed communicatio
placed on the barrel of the axis (1
is conducted over the barrel *o* on tl
thence over the roller (2), thence

Fig. 9.



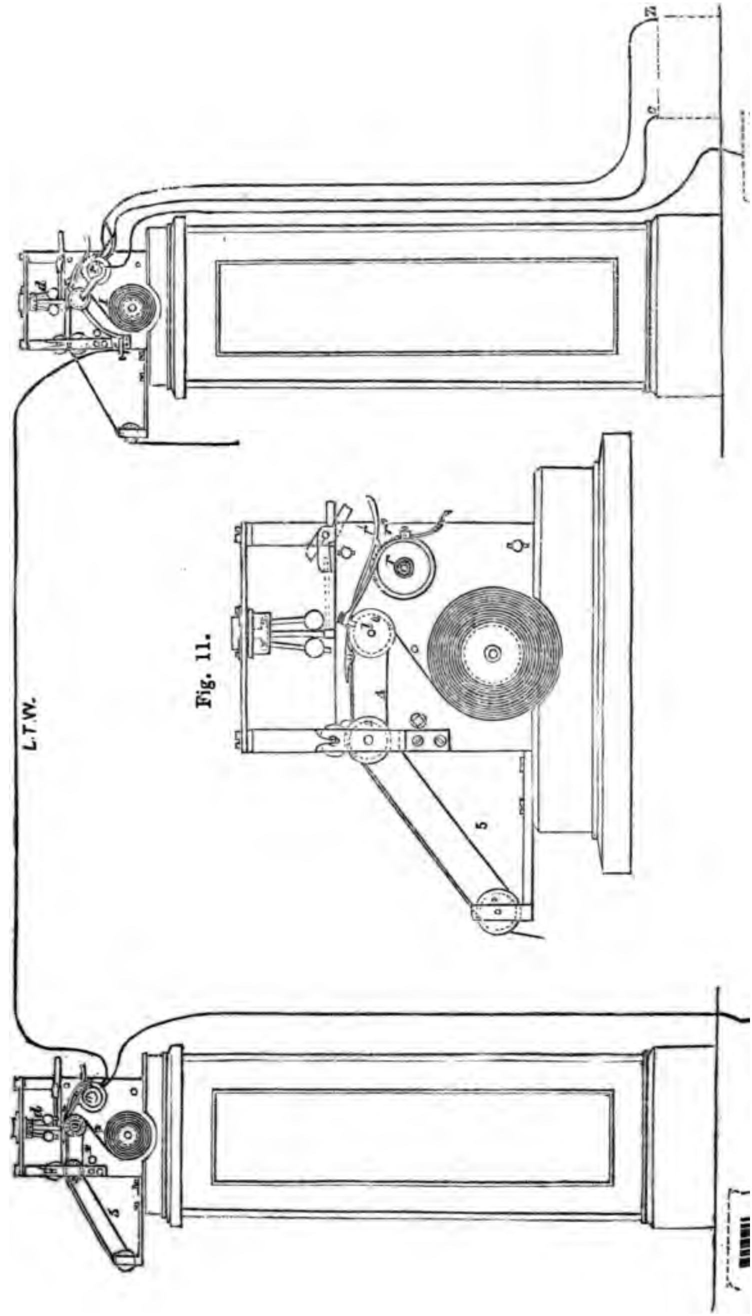


Fig. 12.

Fig. 11.

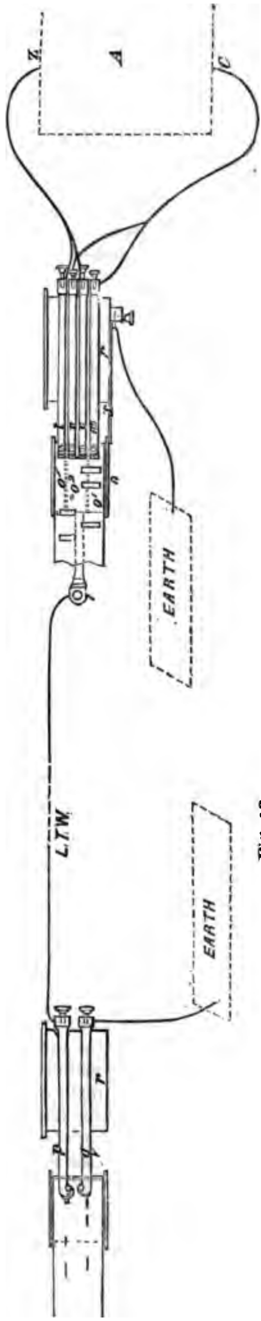


Fig. 8.

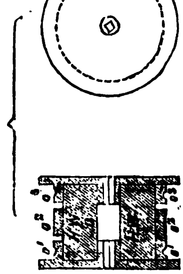


Fig. 13.

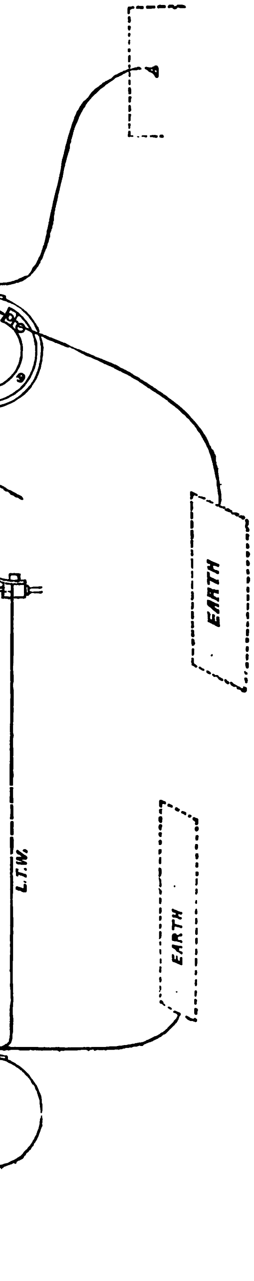
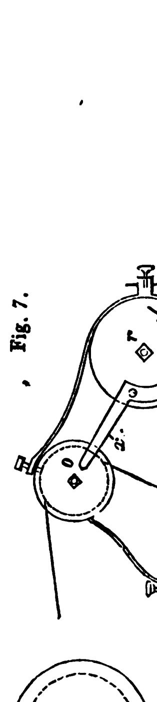
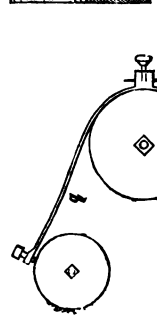




Fig. 7.

roller (3); and to facilitate the movement of the paper, and to support it, there are grooves formed in the barrel o, also in barrels (2) and (3), in which endless India-rubber bands are applied, as shown at (4) and (5). On the axis of the pinion l is fixed the barrel o, shown in section separately at fig. 13, which is composed of three parts o^1 o^2 o^3, the part o^2 being insulated from the other two parts, the other part o^1 o^3 being in metallic communication with each other.

(To be continued.)

ETHERIZATION—THEORY PROPOSED.

Respected Friend,—The modern discovery of producing insensibility to pain, by the inhalation of ether, has given rise to various speculations, as to the cause of such apparently wonderful effects; but thus far the sum total of what has been said on the subject, amounts to no more than that the vapour acts on the muscles and nerves which produce sensation—as if all the nerves were not alike in that respect. In my opinion, this phenomena is simply the result of cold, caused by the rapid evaporation of the ether, which has come in contact with the nerves, by inhalation; the cold producing a numbness, or inanition, throughout the nervous system, as soon as the vapour has acted on the brain,—the brain being the root of the nerves. That this is the cause of insensibility may be almost proved by a simple experiment: if the hand is immersed in ether, and then exposed to the atmosphere, a sensation is produced almost instantly, which is so singular that we scarcely know whether it is cold or a burning heat. This arises simply from the cold being produced on the skin by the sudden evaporation of the ether, while the blood beneath is still warm. Now, in inhaling ether, the vapour is rapidly transfused over the nerves, and as rapidly evaporated, the heat being by this operation abstracted; and as soon as its effects have extended to the brain, life is, as it were, suspended in the nervous system: for life is soon extinguished if heat is entirely abstracted from the body. This view of the subject would explain in a simple manner the cause of the operation having proved fatal in some cases; the body, previously weakened by disease, does not possess the power of recovering the heat which it has lost, anc becomes gradually cold, until l extinct. If this theory is corre may suppose it possible to preven results, by applying heat, after o ing, either externally or by elect The latter would be, probably, th mode, as the most expeditious; must be evident that it is imprud continue the inhalation during ɛ period, after the system has bee hausted by emaciation and sufferin

I suppose that many other might produce the same results the rapidity with which sulphuric evaporates, must render it safer th other, when used by inhaling it. probable that the cause of spirits o pentine curing a burn on the skin its abstracting the heat in evapor so that ether would, without doub swer better for this purpose als may be worth a trial, as its success confirm the truth of the above the

These speculations may lead question—What is mesmerism? world is so divided on the subject one would be led to suppose it d to settle the matter; the medical on the one hand, denouncing it delusion; and the mesmerists, o other, asserting it to be a myst agent, the effects of which they su are sufficiently unlike those produ other causes, to lead to the conc that it has nothing in common etherization. That insensibility t has been produced by its mean hardly be doubted; yet this is no i for magnifying a really simple p mena into a mysterious principle, f purpose of exciting the wonder ignorant. I would suppose that th rator does nothing more than ab heat from the nerves, by what is teriously termed, "the passes;" other words, the heat, in circu through the body, is arrested o weaker nerves, by the influence other individual of a stronger fram not by the aid of the imagination. fact of nervous diseases having partly removed by mesmerism, is s due to the mental consciousness of being temporarily removed through tially disconnecting the mind fro brain; by stopping the usual fun of the nervous system; and whethe is effected by inhaling ether, or b

; of the hand on the nerves of idual, the effects are, in reality, e same, however different they rently be; but the ether acts all cases with certainty, while rsterious process the reverse is the case. It is probable that erists will not acknowledge that philosophy of the thing, after oclaimed it as the source of wonderful under the sun. A so simple is something like ie magic lantern, or like ana- niversal medicine, and show- cipal ingredient to be nothing flour; the mystery having l, there is no magical power

rt of the above it may be re- t *cramp*, which is the result the nerves, almost entirely e consciousness of external e, if it reaches the lungs or fe is soon extinguished by ı all probability, the circula- t through the nerves. We trace many apparently dif- s to the same cause—absence

f etherization which deserves that while all physical sen- it, the faculties of the mind itly stronger than at other nind being then in a perpe- f thought. This seems to be f the mind being rendered independent of the body, e immobility of the nervous t no sooner is physical sensa- ed, than this extraordinary and the mind being chained its power is again limited. , that far from matter being the existence of mind, it is of the mind; consequently, ie moment the mind becomes pendent of matter, the facul- ee scope, and expand to an eater extent. Yet strange as ar, the greatest advocates of are materialists. Let these theorists, and their brother xamine the subject more n they have hitherto done, vill see that what is really oo simple to aid the propa- the principles which they

Would not the above theory be confirmed by that advocated by Dr. Payerne in your pages,—cold is the result of the chemical repose of bodies, (or matter,) heat of their animation or mobility?

I remain respectfully,

JOHN DE LA HAYE.

Liverpool.

THE CENTURION PAPERS.—No. 1.

Our readers were some time ago apprized that a considerable number of papers left by the correspondent who signed "Centurion" in our pages, had been communicated to us by his son. Amongst these are many curious investigations relating to isolated geometrical, and other problems and theorems; some more complete dissertations; and a not inconsiderable number of physical and metaphysical researches. We shall, as we promised, give selections from all these from time to time, as occasion serves; beginning with the briefer and more isolated propositions — though holding ourselves at liberty to depart presently from this plan, for the sake of variety.—ED. M. M.

1. *The "Flat Knot."*

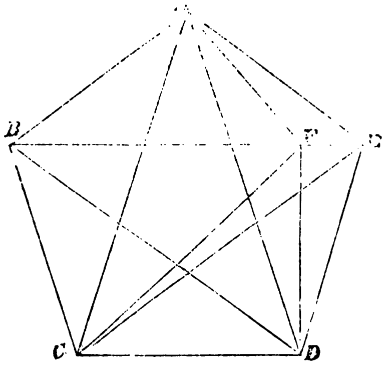
All the world knows that from time immemorial, there has existed a method of "tying up a note" in what has been appropriately called a flat knot. Nobody, perhaps, had thought of the geometrical character of this knot, till a few years ago, it was proposed in one of the Trinity College papers (1833), to show that the knot itself was a regular pentagon. No proof of this, though admitted on all hands as a truth, has been published—at least as far as I have been able to discover. The following method, however, does prove it; and that, perhaps, as simply as it can be done:

1. No smaller number of folds than five will make a complete tie. The figure must, therefore, be a pentagon of some kind.

2. Each angular point of the tie must coincide with one or other of the parallel edges of the slip of paper.

3. If the diagonals of a regular pentagon be drawn, each will be parallel to the side of the pentagon, which is non-contiguous to it; and all the trapezoids so

formed will be equal and similar. Thus,



BE is parallel to CD, AC to DE, and so on; and the trapezoid BCDE is similar and equal to ACDE, and similarly to all the others.

4. If a pentagon be not regular, these conditions are not fulfilled.

For, let us take the most favourable case for its fulfilment; viz. that AB, BC, CD, are three of the sides of a r pentagon; and the remaining a point F be situated in BE, E bei fifth angular point of the *regular* gon. Join CF.

Then CE is parallel to AB; a our contra-hypothesis, CF is also lel to AB; whence CE, CF are p But they meet in C; which is abs

Wherefore, in no pentagon but a lar one can all the diagonals be p to the non-contiguous sides of the

5. Since by the hypothesis c theorem, every diagonal and eve are one or other of the parallel ec the slip of paper; and since by wl been shown in (4), this conditic only be fulfilled when the penta *regular;* it follows that the "flat cannot be other than a regular per as affirmed in the proposition. W *etc.*

[*Note.*—We observe that this lem is also proposed in Mr. Pott's v cellent edition of Euclid, as an ex upon the fourth book.—Ed. M. M

2. *Tri-rectangular Pyramid.*

(α) A triangular prism has its three angles at the vertex right angles: show tl sum of the squares of the areas of its three faces are together equal square of its base.

(β) If the three edges of the pyramid be $\sqrt{3}$, $\sqrt{5}$, $\sqrt{7}$; find the area of th and the volume of the pyramid.

Solution.

(α) Put a, b, c for the three edges: then, their faces will be $\frac{1}{2}ab$, $\frac{1}{2}bc$, $\frac{1}{2}ca$ the edges of the base will be

$$\sqrt{a^2+b^2},\ \sqrt{b^2+c^2},\ \sqrt{c^2+a^2}.$$

Whence (Hutton's Course, 12 ed., p. 473,) we have

$$\text{area}^2 = \tfrac{2}{16}\{(a^2+b^2)(b^2+c^2)+(b^2+c^2)(c^2+a^2)+(c^2+a^2)(a^2+b^2)\}$$
$$-\tfrac{1}{16}\{(a^2+b^2)^2+(b^2+c^2)^2+(c^2+a^2)^2\}$$
$$=\tfrac{1}{4}(a^2b^2+b^2c^2+c^2b^2).$$

Also, the sum of the squares of the three faces, from the formulæ abo the same quantity. Whence the theorem is proved.

(β) By the preceding, we have

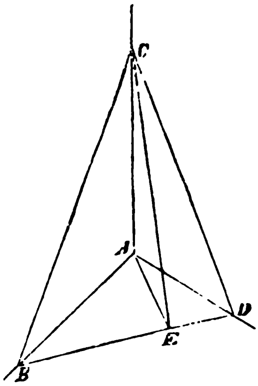
$$\text{base} = \sqrt{3+6+7} = \sqrt{16} = 4.$$
$$\text{vol} = \tfrac{1}{3}\text{ area of one face by the remaining edge}$$
$$=\tfrac{1}{3}\cdot\tfrac{1}{2}\sqrt{3.6.}\ \sqrt{7} = \tfrac{1}{2}\sqrt{14}.$$

Scholium.—The theorem (a) was first noticed by Monge, who gave it in his *Géométrie Descriptive*, and a demonstration of it has been given in some English works, something after the manner of the ancient geometers. "Davies's Solutions of Hutton's tions," p. 335. It has not, I however, been anywhere treated the solution above.

Editorial Note.—As Mr. Davies's Solution is referred to by our friend of valued memory, we copy it into our pages; convinced that it will be interesting to those of our readers who may not be able to consult a now somewhat rare work, which we know occupied much of the time of one of the most valued contributors to this Magazine. Our friend very properly uses the phrase, "something after the manner of the ancient geometers" in describing such proofs: but in fact, the principle of the enunciation of the theorem itself was not recognised—nay, was even rejected by the illustrious fathers of the science—and hence there can be no closer analogy to their methods in the demonstration than there is in the enunciation. The school of Euclid would, probably, have given it in a form not essentially unlike this:— "If four lines be taken proportional to the three faces and the base of a pyramid, whose three angles at the summit are right angles: then the sum of the squares of the first three lines is equal to the square of the fourth." But we proceed to the solution in question.

"Let AB, AC, AD be three edges of the pyramid, whose base is BCD, and the three vertical plane-angles at A right angles. From A draw AE perpendicular to BD and join CE. Then CE is perpendicular to BD (theor. 102).

"Now in the right-angled triangle BAD, we have



$$BA \cdot AD = BD \cdot AE, \text{ or } BA^2 \cdot AD^2 = BD^2 \cdot AE^2.$$

"Again, $CA^2 \cdot AB^2 + DA^2 \cdot AC^2 = CA^2(AB^2 + AD^2) = CA^2 \cdot BD^2$;

Hence adding,

$$BA^2 \cdot AD^2 + DA^2 \cdot AC^2 + CA^2 \cdot AB^2 = BD^2(AE^2 + AC^2) = CE^2 \cdot BD^2.$$

"Now $BA^2 \cdot AD^2 = 4(\triangle BAD)^2$

$DA^2 \cdot AC^2 = 4(\triangle DAC)^2$

$CA^2 \cdot AB^2 = 4(\triangle CAB)^2$

$CE^2 \cdot BD^2 = 4(\triangle BCD)^2$.

"Hence the proposition is true."

(*To be continued.*)

METHOD OF JOINTING AND LAYING GLASS TUBES.

Sir,—The following account of certain methods, proposed by me for jointing and laying glass tubes, which was written for a different object some time ago, may yet be of interest in the pages of your magazine.

My methods of jointing glass pipes are twofold; and, stated generally, consist either in the application of the electrotype process, to form a metallic joint, in whatever way or form, so as to close and join the ends of two contiguous pipes into a continuous tube; or, secondly, in the application of the process of tucking or constricting a flexible metallic collar round the contiguous ends of the pipes of glass, placed *in situ*, which process has been already used for closing metallic capsules over the corked mouths of certain bottles. Both processes may be varied much in detail; but the following are the details of practice which I would advise for adoption under each of the two heads of my invention:

First, *for closing the joints of glass pipes by the electrotype process*, the ends of the glass pipes are to be formed with a collar slightly projecting outwards, which is to be ground, or otherwise made flat and truly square to the axis of the tube. In laying the lengths of pipe together, these collars may be either doubly

abutted dry, or a little resinous, soft cement, or marine glue, or other fit, but not too hard cement, may be interposed; or a flange or washer of vulcanized India rubber, gutta percha, or cork, felt, or other fit material, may be interposed. A longitudinal section of the joint without flange is shown in fig. 1, and with cork or India-rubber flange in fig. 2.

Fig. 1.

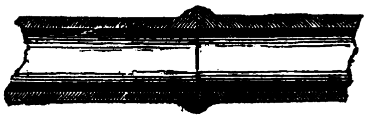
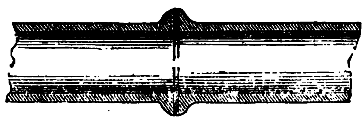
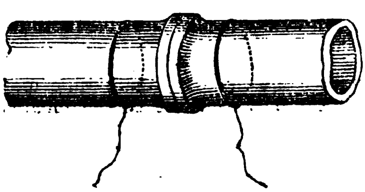


Fig. 2.



Being so placed previously, the end of each pipe is to be brushed over with turpentine, or other fit varnish, for about an inch in width round the collar, and dusted over with fine plumbago, or coal gas retort carbon, or bronze powder, or gilded with Dutch gold, or *metallized* on the surface in any other way. The metallized surface is then to be put in connection with the poles of a constant battery, by wires affixed in any convenient way. I prefer to twist a common copper bell wire round each length of pipe, close to the edge of the metallized surface, *remote* from the joint, for this purpose, as shown in fig. 3.

Fig. 3.



The joint, and a few inches of the pipes at either side of it, are now to be immersed in a solution of copper, or of any other suitable metal capable of being electrotyped, and metallic copper or other metal precipitated in a malleable closely-fitting ring round the junction, by which means the joint is finally and effectually closed. A convenient mode of imn horizontal or vertical pipes in t tallic solution, is to place them in wood box, lined with wax or glue, and parted in half, to pern pipe to pass through—the joint box and round the pipe being staunch with soft resinous cemen or other such fit substance. Fig. 4 sents a vertical, and fig. 5 a hoi pipe thus immersed.

Fig. 4.

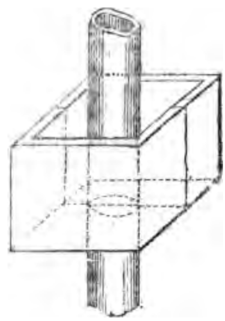
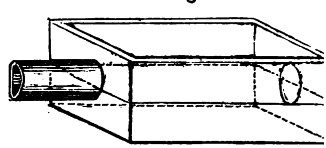


Fig. 5.



Curved pipes may *dip* into any f vessel.

If corrosive vapours or fluids pass through the pipes, a thin gold, or other noble metal, or of l case of sulphuric acid, may be fi posited just at the lips of the jo protect the copper from injury; may be effected by the nature of the between the lips or collars of the which may be hard and incorr The cork or other compressible between the lips of the joint, is to l when change of form in the line of or expansion and contraction, are provided against. It seems unne to enter more minutely into the of the process of depositing the e type metallic collar round each jo this is now well understood by all petent persons. The junction metal, when copper is used, with th

is so accurate, and the metal so tough, that a small thickness (about one-twentieth of an inch) is sufficient to make the joint perfectly staunch under a considerable pressure, and even air-tight; which latter may be further insured by brushing over the edges of the metallic collar, when washed clean and dried, with any quick drying varnish.

If difficulties exist in forming the end collars upon the glass pipes of large diameter, they may be dispensed with, using the pipes with plain ends cut off square, and a loose ferule of metal (as fig. 6), pottery, or glass (fig. 7), or wholly of vulcanized India-rubber (fig. 8), inserted between: the transverse section of the ferule being as shown in these figures,

Fig. 6.

Fig. 7.

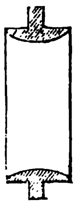
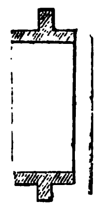
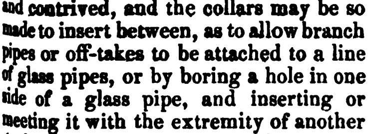


Fig. 8.



and the copper or other metallic ring being then electrotyped over this and round the ends of the adjacent pipes, as before described. Fig. 9 shows a joint so made in section.

Fig. 9.



In fact, very many modifications of jointing in this manner may be proposed and contrived, and the collars may be so made to insert between, as to allow branch pipes or off-takes to be attached to a line of glass pipes, or by boring a hole in one side of a glass pipe, and inserting or meeting it with the extremity of another (a branch pipe). The whole may be jointed, or, as it were, *soldered cold*, together, by the same process of electrotyping. Thus, fig. 10 shows a branch with vulcanized caoutchouc cotton, and fig. 11 a branch electrotyped without any cotton.

Fig. 10.

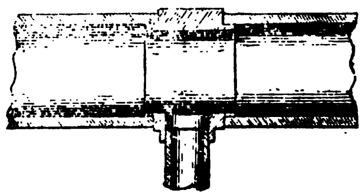
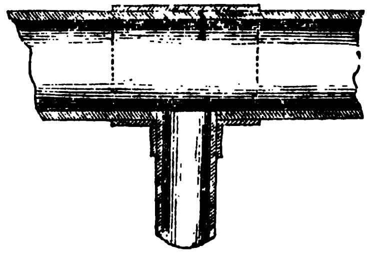


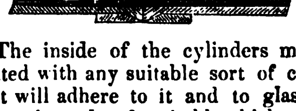
Fig. 11.



The *second* method of jointing glass pipes, *by a flexible metallic collar constricted* upon the pipes, is susceptible also of several modifications. The method I prefer is the following:

The glass pipes being prepared with collars as before described, and laid together, either with or without cement or compressible flanges between, a number of short cylinders of lead, block-tin, pewter, or other soft and flexible metal, are to be prepared. The length of these cylinders may be about $\frac{2}{3}$ the diameter of the pipe outside, the internal diameter being such as will just pass over the outside of the lips or collars at the ends of the pipe. The thickness of these cylinders will vary with the diameter of glass pipe, but should never exceed $\frac{1}{10}$ of an inch, or so, when slipped over the pipes *in situ*. The cylinder will be as in fig. 12.

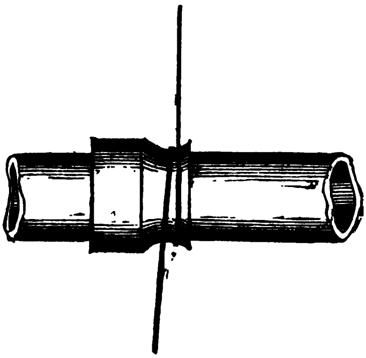
Fig. 12.



The inside of the cylinders may be coated with any suitable sort of cement that will adhere to it and to glass. A greased cord, of suitable thickness, is now to be passed round the cylinder, first at one side and then at the other of

the junction or lips, as shown in fig. 13;

Fig. 13.



and *while* the cylinder is held steady, the cord is to be drawn tight, and pulled rapidly back and forwards by the ends, so as to cause it to revolve back and forwards round the cylinder, by which means it will rapidly be *tucked in* or *constricted* round the glass pipe; and the same operation being now repeated at the other side of the joint lips, the flexible metallic cylinder will have completely moulded and applied itself to the outer surface of the joint, and made the same staunch for any moderate pressure from within.

The cord is best used attached to an elastic wood bow, like a large *drill bow*.

The cylinders of flexible metal must have no solder joints, but must be made out of one piece, either *drawn* or *struck* up, in the same way as Rand's patent collapsible paint-vessels are made. When this method of jointing is used, and much pressure is to be internally sustained, a copper or other wire may be bound round each end of the *constricted* and finished cylinder, so as to aid its resisting power.

This is the cheap mode I would advise for laying glass pipes, under n pressure, under ground. Mari seems an excellent cement to cylinders with for this purpose constriction. During the process striction the ends of the adjoini had best be steadied by the inse a loosely-fitting plug of soft pine wood, to be pulled along from joint, as the line of pipes is laid.

Branches may be taken off made in this way by forming a opening and short cylinder up flexible joint cylinder, and closing the branch pipe, also provided end lip or collar, as shown in fig

Fig. 14.

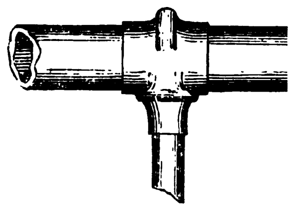
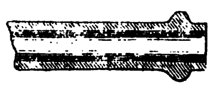


Fig. 15 represents the lip for pipe.

Fig. 15.



A method is successfully ado France of carrying undergroun pipes, free from danger of breal unequal external pressure, viz. bedding them in a mass of hard te mud or clay, prepared by a cyl mould to receive the lower semi ference of the line of pipes, ove the covering of tempered clay i wards filled to the depth of 10 inches for large pipes.

BALANCED BRACKET GIRDER FOR BRIDGES, VIADUCTS, ETC. JAMES DRE OF BATH, CIVIL ENGINEER, INVENTOR AND PROPRIETOR.

[Registered under the Act for the Protection of Articles of Utility.]

Fig. 1.

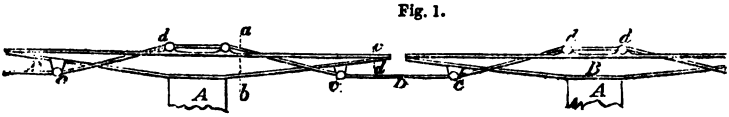


Fig. 3.

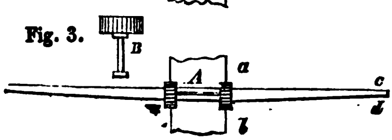
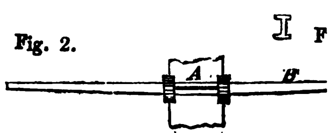


Fig. 2.



F

Fig. 1 is an elevation of this girder; fig. 2, a plan; fig. 3, transverse section, on the line *a b* of figs. 1 and 2; and fig. 4 is a transverse section on the line *c d*.

A A are the abutments upon which the girders rest. B B are the cast girders tapering from the abutments A A, to the extremity. These girders are flanged at top and bottom, and the flanges are also made to taper, as represented by B B, in fig. 2; *c* is an ear cast on the girder B to serve as an attachment for the truss rods D D. These truss rods are employed in the usual manner, that is, the diagonal bars *d c* are bolted to ears *d* at the upper edge of the girder, whilst at the lower end they are fastened to the ear *c*.

SMOKING PIPES.

Sir,—Having noticed in your very excellent work an improvement in smoking pipes, I beg leave to suggest an improvement in pipe tubes of a similar construction, but which is applicable to either a Dutch, China, or Meerchaum bowl. The greatest objection I see to "J.M.'s" invention is, that the cylinder he inserts will be very liable to get burnt and blocked up with the tobacco. Besides, he would require to have pipes made expressly for that cylinder; whereas my tube will suit any pipe. The annexed figures show a mode of construction whereby the longest passage may be procured from the pipe head to the mouth, which is the most desirable object in a tube. A represents the outer case which may be made of zinc, and neatly japanned, *c* an inner cylinder with a spiral twist round, as represented by D; this tube should be made of hard wood, and the twist D should be made of a narrow slip of hard leather, which would cause it to fit the tube A tight. B B are the holes for the smoke to pass through; E is the cork at the end for fitting the pipe tight, as usual in all tubes. F is the mouth piece; G is a small metallic tube (or glass) fitted and fixed into the end of the mouth piece F. These tubes may be made of any length to suit the taste of the smoker.

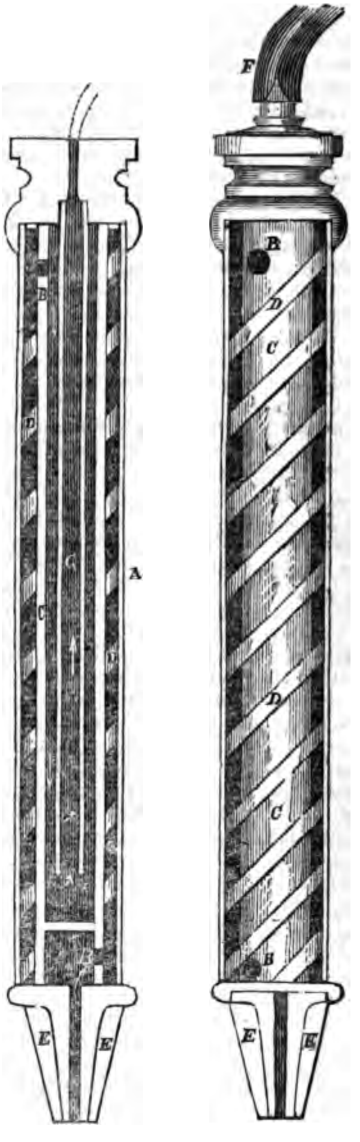
I remain, Sir, a constant reader,

M. W. Lythe.

Tobacconist.

Hull.

P. S. One I have now in use of this construction answers admirably, and de-



cidedly improves the flavour of the smoke.

YACHT SAILING.

Sir,—In offering a few remarks upon the sails and sailing of yachts, I wish it

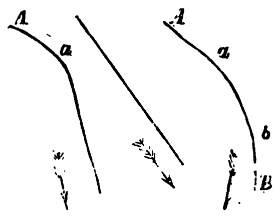
to be understood that they are brought forward, not as professing to contain original ideas or new inventions, but as the ascertained results of experience. Most of the following notions may have occurred severally to many of your readers, and it is with the desire of extracting from *them* more enlarged discussion on such points, that I bring them briefly under their notice.

I shall not offer any excuse for the free use of technical terms, because it is plain that those who are ignorant of nautical matters would find no interest in the subject, however more intelligibly expressed.

We may in considering the sails of the cutter-rig, divide them into those before, and those behind, the mast.

I. The jib and foresail. The jib is generally regarded as a lifting sail, and is supposed to be superior to the foresail in that important quality. But if both sails be sheeted home, and be considered as plane surfaces, it is evident that a normal to the jib makes a less angle with the horizon than that to the foresail. Nor will either jib or foresail be a lifting sail, when by heeling over to a breeze the normal becomes horizontal. Compared however with other fore and aft sails, a cutter's mainsail must always be a depressing sail, and could not be made to lift unless the peak were restrained by vaugs. It is a feeling almost natural to approve a gentle swell in a sail, but I think that a moment's consideration will convince us that the slight advantage arising from the greater resistance to a concave surface than to a plane is overrated, and indeed is outweighed by the concurrent drawbacks.

Fig. 1. Fig. 2. Fig. 3.



1st. If the form of a horizontal section of the jib be as in fig. 1, and if the part A *a* near the tack really holds wind, it is evident that the whole sail could be set with advantage if its horizo tion were a tangent to A *a* at fig. 2.

2nd. If fig. 3 be the horizontal and the proposition be allowed normal resolved force is the only one when wind acts upon ca must follow that the part of the is actually opposing the motio vessel.

3rd. Although the motion of t parallel to the surface of a sail affect it, still the current thus will most certainly act on any upon which it is afterwards Hence, if the draught thus p falls on the lee side of the foresail be seen, that moving in the dire the arrows in the three cases resp it will be more prejudicial as in fig 3 than as in fig. 2. Due regard is to the effects of this powerful parallel to the surface of the jib find it in general fashion to m leack of the jib overlap the foresa times by 6 feet. The upholders system assert, that by having a foot to the jib we leave a large without canvas, and that this n does not cause the foresail to sh would answer, that a considerab is required to permit the escap wind after expending its effect jib and *having its direction ch* and that if the foresail did *not* st under this usage, there would in no room to doubt its being indef This is a very important and int point, and is much canvassed sailors. May I hope that ad light will be thrown upon it by your nautical correspondents. cutter can be relied upon as liv sure in stays, I should always p back the *jib and not the foresai* know many sailors who never foresail in putting about. Up subject it must be remembered jib is less sensitive than the fores has far more leverage and giv *little stern way* when put bac working to windward through a channel or a river, this last-me quality will be appreciated; but th servations are intended to apply cutters which can be trusted to g all standing, and which have never what it is to be *in irons*. Yours

JOHN MACGRE

REMARKABLE PROPERTIES OF NUMBERS.

r,—I am not aware that the follow- properties of the number 123456789 been ever remarked before—if they , my letter must be regarded as an- instance of a "resuscitated inven- '

123456789 be multiplied by any er under 27 that is not a multiple the product will consist of the same series of figures 1, 2, 3, 4, 5, 6, 7, 8, 9, only arrranged in different order; and when the product consists of more than nine places of figures, the additional digit is either a 9 or 0. This will be evident on examining the following table of the products of 123456789 with the different numbers:

1	123456789	14	1728395046
2	246913578	16	1975308624
4	493827156	17	2098765413
5	617283945	19	2345678991
7	864197523	20	2469135780
8	987654312	22	2716049358
10	1234567890	23	2839506147
11	1358024679	25	3086419725
13	1604938257	26	3209876514

it is multiplied by a multiple of product with the multiplier added rill consist of a repetition of simi- ltiples of 37, terminating with a r.

r instance,

```
                        123456789
  ltiplied by 3 × 17 =         51
                       ----------
                        123456789
                       617283945
                       ----------
                       6296296239
  d the multiplier             51
                       ----------
                     629,629,629,0
```

being 37 × 17.

en, however, the multiplier exceeds '×3), the corresponding multiple will consist of more than three , and the last figures of one will nd blended with the first of the

r instance,

```
                        123456789
  ltiply by 3 × 49 =          147
                       ----------
                        864197523
                       493827156
                      123456789
                      -----------
                      18148147983
  d the multiplier            147
                      -----------
                      18148148130
```

w 37 × 49 = 1813.

erefore

```
        1813
           1813
              18130
        -----------
        18148148130
```

This property, like that of the decimal expression for $\frac{1}{7}$, mentioned at p. 512 by your correspondent "J.," might be found of advantage to schoolmasters.

There is another fact relating to this same number 123456789 already well known; viz., that if the order of the digits be reversed, and the number itself be substracted from the reversed number, the remainder still consists of the same figures, only in different order. Thus,

```
987654321
123456789
---------
864197532
```

I will add a few words on a property of pounds and shillings, and shillings and pence—not the invariable property they possess of making themselves scarce, but the following:—In any sum of pounds and shillings, if the number of pounds with the number of shillings added to it, be divisible by 19, the sum is a multiple of 19 shillings.

Take for instance £50, 7s. :—

Here, $50+7=57=19\times 3$.

And £50 – 7s. = 1007s. = 19 × 53.

In any sum of shillings and pence, if the number of shillings together with the number of pence be divisible by 11, the sum is a multiple of 11 pence.

Take for example 31s., 2d. :—

Here $31+2=33=11\times 3$.

And 31s. – 2d. = 374d. = 11 × 34.

These two last can be easily explained on the same principle as the well-known property of the number 9. But the fact that 123456789, multiplied by a non-

multiple of 3, should reproduce the same figures, is, I must confess, to me unaccountable.

I am, Sir, yours, &c.,
J. E.

June 23, 1847.

THE ARCHIMEDEAN BALLOON.

Sir,—As the objections made by Mr. M'Gregor to my Archimedean balloon, although true in principle, seem hardly applicable to that machine, I venture to intrude once more upon your valuable pages with a few remarks, which I shall make as brief as possible.

Mr. M'Gregor complains of the unscientific manner in which a motive power, proper for aerial navigation, is generally proposed to be applied; and states that "the propelling machine is suspended, and its direction of force consequently some 50 feet distant from that of the resistance offered by the atmosphere." Correctly speaking, my propelling apparatus is not suspended from the balloon, but the latter is firmly attached to the machine by posts and ropes; the gas is applied merely to diminish the weight, the paddles are to lift the machine in the required direction, and are, in fact, the. true suspenders. The elevation of my machine was drawn on a scale of 20 feet to an inch, and the section on twice that scale; and from considering the atmospheric resistance exerted below the paddle-wheel shafts, as well as that exerted above them, it will be seen that the central point of atmospheric resistance, so far from being 50 feet above the line of propulsion, is not so much as 10 feet. Whether or not the cylinder would require enlarging to so great an extent as to bring the centre of horizontal resistance to so great a height, remains to be proved. As it is, the atmospheric resistance preponderating above the line of propulsion will give the whole machine a tendency to rise up in front, which could at once be checked by causing the hindmost paddle-wheels to propel the machine more vertically than the foremost ones, which could easily be done by shifting the guide-wheels. This would certainly involve some waste of power, and the necessity for it might be obviated by constructing the machine with a greater depth below the line of propulsion.

But even this latter remedy Mr. M'Gregor seems to think has its evils; and states, that if the gas-bags beneath the machine were to equalise the horizontal resistance, and be at the same time buoyant, they would throw the whole fabric on its side. Now, seeing that in a machine so constructed, the central line of atm(resistance would coincide with the propulsion, and that the centre of would be, as in the present machine both these lines, I do not see h centre of gravity is to be brought with the line of propulsion, so long machine is supported in the air action of its paddles. For as the fabric is kept from falling by a powe takes effect at the four points wh paddle-wheel shafts enter the hull, these points are above the centre of I see nothing to disturb the equil so long as the atmospheric resist equalised. It must be particularly b mind, that I do not mean the mac be lifted by the gas, but by the p the gas is applied in order that the may be reduced sufficiently for the to cope with it.

Mr. M'Gregor states, that the g under the machine would not suppor selves. According to the scale it found, that making no allowances fc ing, they contain 10,614 cubic feet superficies of 4,196 square feet. the buoyancy of hydrogen gas at 1 cubic foot, we here have a buoy 663 lb. Allowing the casing to wei per square yard, which is strong eno a large balloon, the casing would 87 lb., leaving, therefore, an effectiv ancy of 576 lb. The weight of the might be diminished by the weight o 400 square feet, by having the thr made into one. In calculating the of the casing, the frame-work must reckoned, as that would be required were no gas-bags.

Taking my machine as it stands sented in the elevation, the main ol to it appears to be its want of bu This may be remedied in some de increasing the size of the cylinder a bags longitudinally; but if the dian the cylinder be enlarged, the depth gas-bags must be increased likewis as there is a limit to the latter, so t to the former. When I planned n chine, I was in hopes that the dian the cylinder might be increased co ably without endangering the equilib the fabric; but as the case appear otherwise, I am now endeavouring to a modification of my machine, whic enable it to carry a large quantity without incurring any risk of los equilibrium, and have considerable h success.

I remain, Sir, yours very respectf
J. Pit

Hastings, July 7, 1847.

)F PREMIUMS.—A HINT FROM
:R JONATHAN TO THE LONDON
' OF ARTS.

ɜ determined not to particularize s included in the exhibition (Fair ıerican Institute), at this time, ıy avoid all occasion for harm or ; on the assumed ground of par- nercenary motives. All has been vas promised by the Institute, and satisfactory extra exhibitions have ı. The whole closed, with a more honoured in the breach bservance," and we would like to he Institute of the fact; we refer rd of *premiums*. This is the only part of the matter; the giving of tends to make the jealous more d the vain more vain. None like r own works surpassed, and par- lo they dislike to have them ad- be so, and by, perhaps, sometimes or incompetent persons. These oundless objections. It has been ıf regret that so great a decrease nber of mechanical inventions and s been noticed at each succeeding . The *premiums* are the cause. no doubt of this. The *premium* ɪral cry.—It was awarded to one, to have been to another. And n said, with how much truth we er, that if every exhibitor was gold medal there would be some l want more.

ı American Institute continue its ıbandon its premiums; and if they ıake a noble disposition of some the vast receipts, let them estab- d for the aid of poor inventors, ot obtain the means of bringing ıe world their valuable inventions, :h a board of direction as is in ɜr to appoint. Let them abandon niums, and announce the fact to , and append the above to such nent, and our word for it, there such a display of mechanical inge- inventive skill as has not yet been l without the premiums the whole ne before the world upon equal d equal rights, and the great in- to exhibit articles would not be a ; but the more useful object of y of each one's manufacture, to ıational gathering of the people at the American Institute, each for the ʼould gain to himself, by a display icles to the mass of society, where 'airly explain, and unbiassed, leave :, the examiner, to judge of the demerit in the premises. Thus ıld ever triumph over might, and the institution gain honour, as it dispenses its usefulness to the world.—*The Eureka, or Journal of the (U. S.) National Association of Inventors.*

POWER OBTAINABLE FROM THE DECOMPOSITION OF WATER—INQUIRY.

Sir,—Allow me to ask, through the medium of your excellent Magazine, the opinion of any scientific man on the following question:—

Would the gases evolved by the decomposition of water, at the poles of a galvanic battery, continue to be so evolved if enclosed in an air-tight vessel, fitted with an escape-valve capable of being loaded with any required pressure, say 40, 50, or 60 lbs. per inch, or even higher, should the vessel be strong enough to stand it?

If such should be the case, and provided the required pressure could be maintained, these gases might, I should think, be made available in driving an engine similar in construction to the non-condensing steam-engine.

The quantity of gases given off would, no doubt, be in proportion to the surface of metal exposed to the water to be decomposed, and to the power of the battery acting upon that metal, as in the case of a steam-engine boiler, whose power is in proportion to the surface exposed to the action of the fire, and to the quantity of coals consumed.

The expense of maintaining the proposed power will, of course, be in proportion to the quantity of battery materials consumed, and can only be determined by actual experiment, as can only the area of generating surface. The idea of using gases thus obtained, as a source of power, occurred to me two or three years since, and has lately been revived by reading the accounts of the compressed air locomotive.

Without trespassing more on your valuable space, I beg to subscribe myself,

Your obedient servant,

A SUBSCRIBER.

Plymouth, July 6, 1847.

IMPROVED SPARK ARRESTER.

Mr. James Milholland, Superintendant of road and machinery on the Baltimore and Susquehannah Railroad, has made, it is said, a valuable improvement, which effectually arrests the escape of sparks and cinders, while its construction permits the smoke readily to pass out of the pipe without obstruction. This improvement cannot but prove of great utility in removing one of the greatest present annoyances to the travelling public, and which will be appre-

ciated by every one who has suffered from this cause. The Baltimore *Sun* in noticing this improvement remarks:—

In 1833, shortly before that road was completed, Mr. R. L. Stephens, the President of the Baltimore and Susquehannah Railroad Company, suggested the use of a bonnet of wire gauze to the smoke pipe, which was tried in several forms, until at last it assumed the shape of the frustrum of an inverted cone, surrounding the pipe for some distance below the top and covered by a hemispherical cap of the same material. This arrangement was found to arrest the sparks which fell into the conical pocket formed around the pipe by the lower part of the wire gauze; but here another difficulty arose: the accumulated sparks were fanned by the rush of air produced by the rapid motion of the engine, into a fierce fire, which soon destroyed the wire netting, permitting them to escape as before. The most obvious remedy for this was to exclude the air, which was done by enclosing the lower part of the cone with sheet iron, which answered very well until the accumulation of sparks filled the iron, when they were again ignited by the rush of air. Another and another portion of the cone was covered, until it was found necessary to have the whole of the inverted cone made of sheet iron, with a door in the lower part, to extract the extinguished sparks from time to time during stoppages. In order to enlarge this receptacle for the sparks, the cone was extended the whole of the way down the pipe, which arrangement is at present in use in various modifications on the railroads of the United States. By one of those singular coincidences which often occur in the discovery of useful improvements, the same results were obtained by Mr. H. C. Wyatt, of Weldon, North Carolina, in a course of humbler experiments. He adapted the same arrangement to the bowl of a tobacco pipe, and by blowing into the stem of the pipe, the smoke was driven through a perforated tin cover and the sparks arrested in the same manner precisely. Mr. Wyatt obtained a patent for his invention; for the infringement of which, his assignee lately recovered a verdict in the United States' Circuit court.

Mr. Milholland's improvement consists of a globe of perforated sheet iron covering the top of the smoke pipe, surrounded at a short distance by a shield of close sheet iron to exclude the air, with an opening at the top sufficient to permit the escape of the smoke. From the bottom of the perforated globe a pipe conducts the sparks into an air-tight iron box, sufficient to contain all the sparks arrested during the usual trip of the engine. This box Mr. land calls by the expressive term sub-treasury. The large and powerl motive William H. Watson late under the superintendence of Mr. land, at the Boulton depôt, is fitted this improved spark arrester, and informed it fully answers his expec —*The Eureka.*

THE ROSSE TELESCOPE.

Professor Mitchell, of New Yo recent lecture on astronomy, gave lowing vivid picture of the wonderfu veries achieved by the telescope c Rosse:

"Let me now consider the ins constructed by that distinguished n Lord Rosse. Distrusting the powe refracting telescope, he determined his energies to the construction of a ing telescope that would enable him greater discoveries than any hithert I need not detail the constructio mighty instrument. Instead of lim *speculum* to four feet, as Herschel h he gave it *six*, with a focal distance *feet.* The capacity of this instru wonderful. Such is its power, that of the first magnitude were removed a distance that its light would be six sand years in travelling to our ea telescope would reveal it; were it r so far that its light would be three of years in reaching us, this telescop nevertheless, show it to the human e it to be wondered at, then, that wi an instrument grand discoveries sh made? It has been pointed to the l and although in the beginning on career, it has already accomplished things. There are nebulous spots heavens which have baffled all the ments hitherto constructed: but this t resolves their true character com Among the wonderful objects whi been subject to its scrutiny, is the n the constellation Orion. I have had portunity to examine it. It is one most curious objects in the whole l It is not round, and it throws off lights. From the time of Herschel been subjected to the examination most powerful instruments, but it gr and more mysterious and diverse in racter.

"When Lord Rosse's great telesc directed to its examination, it for time resisted its power. He foun quired patient examination—nigh night, and month after month. At pure atmosphere gave him the resol

tution, and the stars of which it is
l burst upon the sight of man for
ime."

AMERICAN PATENTS TO BRITISH SUBJECTS.

delighted to observe in the Re-
1847 of the American Commis-
Patents (just issued) the following
d sentiments on this subject:
existing law, a subject of Great
required to pay into the treasury
500 dollars before his application
mined. The citizens and subjects
ier foreign countries are each
o pay into the treasury a duty of
s on their respective applications.
ies were designed to bear some
i to the duties acquired of Ame-
zens making applications for pa-
her countries, and on that ground
aps, be justified and defended.
of this provision is unquestion-
event the introduction into this
f many useful and valuable dis-
which would otherwise be patented
duced. Similar high duties have
to exclude American inventions
r countries. Thus, all countries
l by this system of taxing genius
ertion of its powers, in order to
paratively a very small and trifling
revenue.
rds no protection to the American
keep out the discoveries of his
ulator (not rival) in the arts, by
emanations of his genius with
s, while the country would derive
fit from their introduction.
fore, it is respectfully submitted
t would not be expedient were
to provide contingently for the
of the duties required on applica-
itents by the citizens or subjects
a governments to thirty dollars,
it shall appear that corresponding
have been made by those govern-
the duties required of American
I have reason to believe that the
n would be received with favour
f not all, of the European govern-

ENT AMERICAN PATENTS.

from the *Franklin Journal* for May.]

EMENT IN THE FILTERING-COCK.
. Wenman.

ve of this cock is a hollow cone
ito two chambers by a filtering
so that the liquid in passing
hall be filtered.

Claim.—What I claim as my invention, is the application of the filter within the inner cone of the cock, by means of a groove made in the inner cone; also, on the bottom plate placing the two perforated plates, with the filtering substance between them, so that all the water, or other liquid fluid, has to pass through the plates and filtering substance above named, substantially in the manner and for the purpose described."

IMPROVEMENT IN THE METHOD OF CONSTRUCTING TRUNKS. *James Hibson.*

The patentee says,—"My improvement is confined to the skeleton, or frame-work, of travelling and other trunks, and to the mode of connecting thereto the exterior covering. Instead of constructing the ribs (which constitute the skeleton of such trunks,) of wood or metal, I use strips of whalebone, which, by its elasticity, preserves the original shape of a trunk after the latter has been subjected to wet or accidental pressure; these strips, when bent to the required form, are secured to the iron lips of the trunk by having their ends inserted into sockets formed of sheet metal, and riveted to the lips. The lips are united at one side, by metallic or other hinges, in the usual manner. To connect the outer, or leather, covering to the skeleton, I use small clamps, made of thin sheet metal."

PROCESS OF PURIFYING OR CLEANING WHALE OIL. *Patrick Fitzsimmons.*

For the purpose of precipitating the gelatine and albumen, finely pulverized alum is mixed with the oil. The proportion of alum for a hundred gallons of oil is from fifteen to twenty-five pounds, according to the quality of the oil.

IMPROVEMENT IN PRINTING PRESSES. *Alva B. Taylor.*

To avoid the shock and jar at the end of each reciprocating motion of the carriage of the Napier press, particularly when it is attempted to operate the press with considerable velocity, air cushions or springs are used, and made by having a piston or pistons attached to the ends of the carriage, so as to compress air in cylinders attached to the frame. These pistons either enter short cylinders at the end of the motions of the carriage, or the cylinders have apertures near the end, so that the pistons are only resisted by the compression of the air towards the end of the motions of the carriage.

IMPROVEMENT IN THE SELF-ACTING REGISTER FOR STOVES. *Washburn Race.*

An expansion rod is connected at its lower end by a knife edge with a lever which, is in turn connected with the register; so that as the rod contracts by the reduction of temperature the register is opened, and vice versâ.

Improvement in railroad Wheels. *Thomas Glasco.*

This is for a mode of fastening the treads or tyres of railroad wheels to the main rim, or " centre" as it is termed in the specification before us. The outer periphery of the " centre," is made conical to fit the correspondingly formed inner periphery of the tread, and the outer periphery of the " centre" or inner rim is grooved to receive a ring cut in three parts, so that when the outer rim or tread is slipped on, by means of radial screws, the segments of the ring can be forced into a groove in the inner periphery of the outer rim; one face of the segment ring being bevelled so that, when forced out, they (the segments) shall act as wedges to force the outer on to the inner rim.

Magnetic Telegraph. *Samuel F. B. Morse.*

Claim. " What I do claim as my invention is the receiving magnet, or a magnet having a similar character, that sustains such a relation to the register magnet, or other magnetic contrivances for registering, and the length of current or telegraphic line, as will enable me to accomplish, with the aid of a main galvanic battery and the intervention of a local battery, such motion or power for registering as could not be obtained otherwise without the use of a much larger galvanic battery.

" I claim as my invention the use of a local battery and magnet, in combination with a battery and magnet connected with the line or lines of conductors, for the purpose above specified.

" I also claim the combination of the apparatus connected with the clockwork for setting off the paper, and stopping it with the pen lever.

" I also claim the combination of the points affixed to the pen lever with the grooved roller for marking on paper, as above described."

Extension Frame for Bedsteads. *C. S. Debow.*

The patentee says:—" The distinguishing character of my invention is the employment of the well known series of cross levers familiarly known as 'lazy tongs,' placed in a horizontal position, but turned edgeways for supporting, while they can be contracted or extended at pleasure; any number of these being placed parallel, and at a sufficient distance apart, for the purpose intended, and connected by cross bars for purposes above named; when extended forming a bedstead or other supporting frame; and when contracted occupying the smallest possible space."

Improvements in the Magnetic Letter Printing Telegraph. *Ro House.*

Claim.—" What I claim as my in and not previously known in the ab scribed magnetic letter telegraph, is-

" *First.* The manner in which I and combine the finger keys, a ke and a circuit wheel, respectively, purpose and substantially as here scribed.

" *Second.* The combination of the ment with the type wheel, by means in the side of said type wheel corres in number with half the number of and other characters which the typ is constructed to form, and the abo bination and arrangement of the esc and type wheel in combination wi nets, as herein described, and for t pose herein stated.

" *Third.* The combination of t wheel with the lever, by means of pi in the sides of said type wheel equal i ber to the number of letters and ot racters formed, (and by other char mean as well blank spot as the lett dot,) for the purpose of regulating tion of the shaft, to carry the pape der to and from the type wheel, all scribed in said specification.

" *Fourth.* The manner of combi shaft with the lever, by means of and projections on said wheel.

" *Fifth.* The combination of th with the hydraulic regulator, to prod effect herein pointed out, and in the herein described.

" *Sixth.* The manner of produc regulating the several motions of th cylinder by the combined action of t ral parts respectively, as herein de viz.: The hydraulic regulator, the w lever, the type wheel, the eccentri and the rods connected therewith, chets, or catches, and the posts as described. I also claim the manner plying the plumbago to blacken the herein described.

" *Seventh.* The combination of t posing apparatus with the magnet purpose specified."

Improvement in Currycombs *liam Wheeler.*

The patentee says,—" I constr currycombs generally of three long bars of sheet metal, united by rivet transverse bars, one at each end, an the middl of the instrument; the open spac s formed by the junction bars, or lates, through which a la tion of t e dust, which would o lodge in the comb, escapes in the using it.

"The three longitudinal bars are in a trough-like form, being bent twice at right angles, by which means they are rendered perfectly unyielding. The teeth are made along the edges of these trough-like pieces, and they are sometimes rounded off at their ends to remove their angular terminations; the bars constituting the comb being of one uniform length."

COMPOSITION OF MATTER TO BE USED AS A SUBSTITUTE FOR TYPE METAL, AND ON WHICH IMPRESSIONS CAN BE MADE WITH TYPES, &c. *Josiah Warren.*

As this invention gives promise of being very valuable, we insert the specification entire.

"Mould, or matrices, are made of a tough, strong clay, mixed with silex in impalpable powder in sufficient quantity to prevent cracking. These materials are made with water into a strong putty, and kneaded very thoroughly until it has acquired all the toughness that can thus be imparted to it.

"This mixture is now softened with water till it will spread easily and smoothly upon a metallic plate; the thickness of coat varying, according to the work to be done, from the thirtieth to the tenth of an inch.

"The plates, thus coated, are allowed to become about half dry, so that a type impressed into them will leave a smooth *fac simile* of itself.

"Into this coating forms are impressed, as hereafter described in stereotyping plates. These forms may either be an original design, or impressed by an original to obtain a copy. When the coating is required to continue moist a longer time than the above, a heavy coating, with additional silex, from a twelfth to an eighth of an inch thick, is first spread upon the plate, and immediately afterwards the coating first described is spread upon the under coating. It is well to spread, with a light brush, a little thin gum Arabic paste between the two coatings, but not indispensable.

"The above-described matrices are used for music, maps, and similar open work; but for fine, close, or shaded work, and for writing, the coating should be of very fine clay, without any admixture of silex, more than is chemically combined to form the clay. This clay should be of such a nature as will admit of its being spread in the form of a thin mortar, to the thickness of one-thirtieth of an inch, without showing any cracks in drying. Clay of this quality is found along the banks of the Ohio river, near Evansville, Indiana.

"When the coating is intended for a close *Italic* handwriting, it may be spread with a tool so constructed as to leave furrows in the surface at such suitable distances as the writer may desire to have his lines; when this becomes hard enough to cut without following the tool, it may be slightly brushed over with a little olive or linseed oil. The writing is done in the furrows with any suitable tool.

"To write a copper-plate, or running hand, or for close drawings, the following is a good process. Mix a small quantity of gum Arabic paste with the mortar made of the pure clay, as above described, enough to change the colour of the clay a shade darker when dry. Let this coating get quite dry, and brush it over slightly with oil. With another brush moisten each line or furrow before writing on it.

"The writing may be done in the ordinary manner, never allowing the tool used to go quite down to the foundation plate. The cast from this matrix will present a slightly uneven surface, which may be gently ground down with a hone or fine whetstone.

"The following process may be used as a substitute for the method above described:

"Spread a plate with pure clay, say one-thirtieth of an inch thick, or as thick as will dry without cracking; when dry, heat it sufficiently to melt wax. Then rub over the surface a little beeswax, stearine, or tallow, and allow the plate to cool. When cold, spread on another coating of pure clay in which a little olive or linseed oil is thoroughly mixed. This should be worked on as soon as it is sufficiently dry to allow the tool to work freely.

"A great variety of clouded, wavy, or smoky effects, either as parts of a picture, or as tinted grounds, are instantly produced in a matrix by wetting the surface to a creamy softness and applying a brush, or toothed tool, with such motion as may be adapted to the design. This may be termed the *Hylographic process.*

"Type composition, or *silicate of lac.*

"Take one pound of good shellac, say four ounces of good clean tar, melt together over a gentle fire, and then stir into this mixture two pounds of fine siliceous sand. When thoroughly mixed, turn out and flatten into thin sheets, say an eighth of an inch thick. When cold it may be broken up for use.

"Place the matrix over a very gentle heat, in order to expel all dampness; raise the heat a little short of the hissing, or boiling point, then lay over the matrix pieces of the silicate sufficient to cast a plate an eighth of an inch thick. Lay upon this a wooden block of the length and breadth required, and about three-fourths of an inch thick. When the silicate is sufficiently softened to take the impression, take the whole to the

press. Strips of wood, or other material, should be placed upon each end of the matrix plate, as guides or bearers, so that the cast shall be exactly type *height*. This being done, bring the press gently down upon it, until the bearers stop it. When cold, remove the cast from the matrix plate, and with a brush carefully wash the face of the cast without wetting the back of the block. The face of the cast, or type, may be polished with a hone or other suitable substance. It is now ready to take a proof, and, if perfect, is ready for the press. If not perfect, mark the imperfection on the proof-sheet, to be corrected by the following process of

"*Stereotyping.*—Take a metallic plate, previously spread with the coarse under coating, say four of fine sand to one of clay, covered with a coating somewhat finer, as first described; when this is so dry as to leave a clean impression from a type, it is ready for use. Next secure the imperfect cast of the type firmly in a square frame, or printers' *chase*, with guides or bearers, as before mentioned, to prevent too deep an impression.

"The plate, with the clay coatings, is now turned down upon the cast, and placed under the press. The pressure is gently withdrawn, and the imprinted matrix lifted carefully from the cast, or type. (The bearers should have springs, so constructed as to lift the matrix from the type on the withdrawal of the pressure.) This gives a new matrix, in which all the necessary corrections are made, and a new cast taken, as before.

"Stereotyping may be performed by the use of any of the matrices above described, using them when the moisture is sufficiently evaporated to leave a clean impression from a type, as before mentioned. Fine engravings, or any thing of that nature, may be more beautifully stereotyped by the use of a matrix of pure soft clay mortar, spread thinly upon a flat surface of dry clay. Press the engraving into it, and allow it to remain until the whole is sufficiently dried to lift the original from the matrix.

"Coats, or types, for printing *fac similes* of leaves, or other substances, the different parts of whose surface do not vary in height more than the twelfth of an inch, may be readily made by using those substances themselves to impress their form, either in the clay matrix or in a flat surface of the silicate previously prepared to be used as a type.

"The blanks between paragraphs of written or printed matter, whether in the original or in the stereotyped matrices, should be filled up with a mixture of about six parts of fine sand to one of clay, which should be applied about the thic cream. The margins may be fill the same mixture, in the form of mo may be applied with a knife or spat

NOTES AND NOTICES.

Improvement in the Electro-Magnetic ... We are informed that Mr. L. B. Swan, of has discovered a new solution, or excitii for the galvanic battery, which promises great utility to telegraph companies, a saving of *seventy-five per cent.* in the mat ployed, besides a large amount of labour a tion. The improvement consists in furn exciting liquid, which produces an ele galvanic current of uniform power and without the rapid decomposition of the m acids, heretofore supposed unavoidable. tion discovered by Mr. S. does not act ther the mercurial amalgam, and with such tı tion on the zinc as to be scarcely percepti Barnes, (the intelligent telegraph operat station,) informs us that he has used this for *forty-five days*, without alteration, amalgam or acids have been required (e supply the ordinary evaporation), and wit perceptible destruction of mercury or zin which time the battery has been in *cons efficient action!*—*Roch. Adv.* (U. States).

Organ Piano.—The following comm from the *Eureka* of New York:—"I have a pending for a patent upon a new parlou ment which I call an *Organ Piano*—a sesses the qualities of both the Pipe O Pianoforte—so nearly that a good perfo imitate either instrument so perfectly as t an experienced ear. It is made in the f square horizontal pianoforte—though the f be varied to taste. It is judged to posses three times the power of a pianoforte— *swell* is comparatively PERFECT; from est tones of the Æolian Harp to the b six stop Organ, and is effected with pedal fingers, like the pianoforte. It is well ad the slowest church, or the quickest waltz ı *any* movement whatever. In compass 6 taves. I fully *believe* it to be *more durable* keyed instrument of which I have any kno

Malleable Glass—Something nearly as goo fessor Schœnbein, who invented the Gu is stated in the *Revue Scientifique et Indus* have, to a certain point, discovered *Malleab* He renders *paper paste* (papier maché) tra by causing it to undergo a certain metam which he calls *Catalytic*, for want of a mo ligible term. He makes of this new paper panes, vases, bottles, &c., perfectly impern water—and which may be dropped on the without breaking—and are *perfectly transp*

Bronzed Cannon.—According to experime in Prussia, iron cannon bronzed, though (less in thickness than ordinary cannon, v a larger charge of powder.

LIST OF ENGLISH PATENTS GRANT JULY 10, TO JULY 13, 1847.

Samuel Stokes, of Monkwell-street, carpe an improved machine for tracing or engrav solid bodies, or subjects in relief. Six ı July 10.

Robert William Sievier, of Henriett Cavendish-square, gent., for an improved or materials for purifying or decolorizing which material may also be employed as and pigments, and for other like purpos months; July 12.

William Edward Newton, of Chancery-la

engineer, for certain improvements in the manufacture of screws. (Being a communication.) Six months; July 12.

William Langley Beal, of Whitstable, Kent, smith, for improvements in the construction of anchors. Six months. July 13.

Alfred Vincent Newton, of Chancery-lane, mechanical draughtsman, for certain improvements applicable to locomotive engines and carriages employed on railways. (Being a communication.) Six months. July 13.

LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED UNDER 6 AND 7 VIC. CAP. 65.

Date of Registration.	No. in the Register.	Proprietors' Names.	Address.	Subject of Design.
July 10	1126	Sydney Smith	Willenhall	Spindle for door lock.
„	1127	Francis Henry	Willenhall	Bolt.
12	1128	Anthony Binns	Ocean-row, Stepney	Horizontal tidal shifting steps for piers.
„	1129	Deane, Dray, & Deane,	Arthur-street East, London-bridge	Grain, spice, & seed-cleanser, sifter and polisher.
13	1130	Thomas Henry Masters,	York-street, St. James's-square, London	Tobacco-supplier.
„	1131	Alexander Haig	Smith-street, Jubilee-place, Stepney	Portable forge.
14	1132	William Palmer	Sutton-street, Clerkenwell	Glass holder of a candle-lamp.
15	1133	Charles Gillett	Bristol	Universal cravat-fastener.

NOTICES TO CORRESPONDENTS.

A. H. in our next.

Mr. Sutton's communication has been received and is under consideration.

Communications received from W. O.—M. M. F Shuttle—E. S.—A Constant Reader.—J. M. B.

CONTENTS OF THIS NUMBER.

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Mechanics' Magazine,

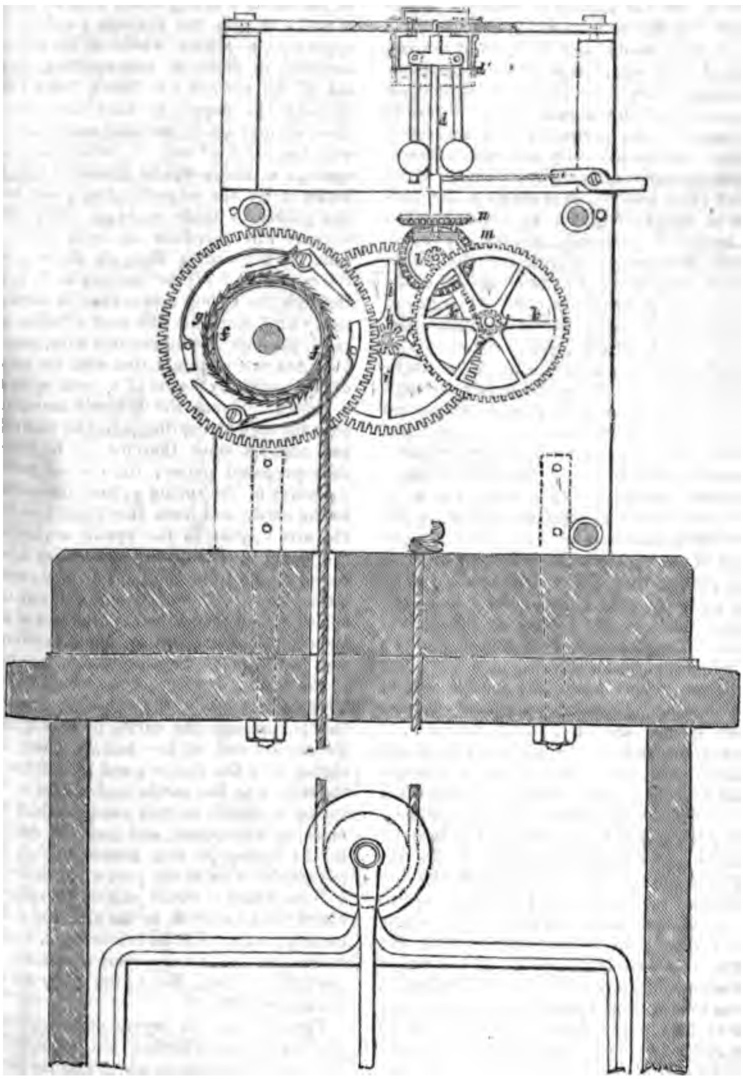
MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 1250.] SATURDAY, JULY 24. [Price 3d.

Edited by J. C. Robertson, 166 Fleet-street.

BAIN'S NEW SYSTEM OF ELECTRO-TELEGRAPHIC COMMUNICATION.

Fig. 11.*



MR. BAIN'S NEW SYSTEM OF ELECTRO-TELEGRAPHIC COMMUNICATION.

(Concluded from p. 54.*)

This apparatus last described is worked with one electric circuit, in the following manner:—The apparatus is shown arranged for transmitting a communication from the apparatus, marked "London"—the end of the apparatus, marked "Edinburgh," being shown in a condition for receiving the communication: and, in the event of it being desired to use the apparatus marked "Edinburgh" as the one from which a communication is to be made, and received at the end marked "London," then these apparatuses will respectively be put into the conditions the reverse of that now shown, which will readily be done by the persons at the respective places. The mechanically-composed communication consists of a perforated paper, which is cut (by a punch), as is shown on the portion of the paper at the apparatus marked "London"—the paper, wherever it is perforated, being so cut that each hole shall either extend partly over the parts o^2 and o^3 of the barrel o, or else over the parts o^2 and o^1 of the barrel o, the effect of which will be, that electric currents from a galvanic battery stationed at A at the end of the apparatus marked "London," will be transmitted through the marking instruments p and q at the end of the apparatus marked "Edinburgh," and by them to the passing chemically-prepared paper (in a moist state), the mark being at all times produced by the marker p or q, from which the electric current is for the time being caused to pass; and the arrangement of the apparatus is such, that the current passing from either instrument p or q, will go to the other instrument p or q, and thence back to the battery at the distant place. The instruments p and q are two metal springs, each carrying a copper point at its end, which constantly presses against the passing chemically-prepared paper: these springs are fixed to the barrel r, of hard wood, and the barrel has at one end some ratchet-teeth formed on a circular plate r^2, and by means of the spring-catch r^1 the degree of pressure of the springs p and q is regulated, by winding the barrel r more or less round on its axis. To the spring p the telegraphic wire from the distant place is fastened by the screw, and to the spring q is affixed the short wire, putting the spring q in communication with the earth, as is well understood. At the end of the apparatus marked "London," the barrel r has four springs affixed to it, in like manner to that above described in respect to the springs p and q, and which are marked t and v and w and v. From the copper end of the battery, at A, a wire proceed has a branch, so that it may be in tion with the springs w and v. F zinc end of the battery a wire p which also has a branch, by which of the battery is put in connection spring t and v; by which arrange electric circuit may be completed b of the barrel o acting either with the w and v or with the springs t and apparatus, as shown, would at the s moment of time be transmitting, aid of the springs t v, there being through the paper, so that the p these springs are in metallic commu with the parts o^3 and o^2, whilst th springs w and v will be insulated f barrel o by the unperforated pape the points of those springs. The current will therefore at such in time be proceeding through the w the copper end of the battery at A through the spring v, working in c tion with t, and from the part o^2 of rel o, through the telegraphic wire, all times in communication with the of the barrel, by means of a metal s is shown. Hence the electric cur pass through the spring p at the ot and make a mark thereby on the cally-prepared paper; then it will the point of the spring q, and then to the earth, and from the earth it the wire x, pass to the spring x^1, the barrel r, and from that spring barrel o, and from the part o^3 of th o the electric current will pass thro spring t, and thence to the zinc end battery. In the event of the next tion in the paper coming under th of the springs w and v, the current tricity will pass in the opposite di that is, through the earth, by passi the copper end of the battery thro spring w to the part o^1, and from th the wire x to the earth, and thence spring q, which, in this case, would marking instrument, and from the to the spring p, and thence thro telegraphic wire to the part o^2 of th o, from which it would pass by the s which works with w, to the zinc end battery; and it will be evident that, desired to make long marks, as sl the table or card No. 1, the paper cut accordingly.

Figs. 14 and 15 represent an ap like that above described, but worke aid of two batteries, in which case th

* Fig. 11,* on the preceding page, is a vertical section of the apparatus of which other views a in figs. 9, 10, a

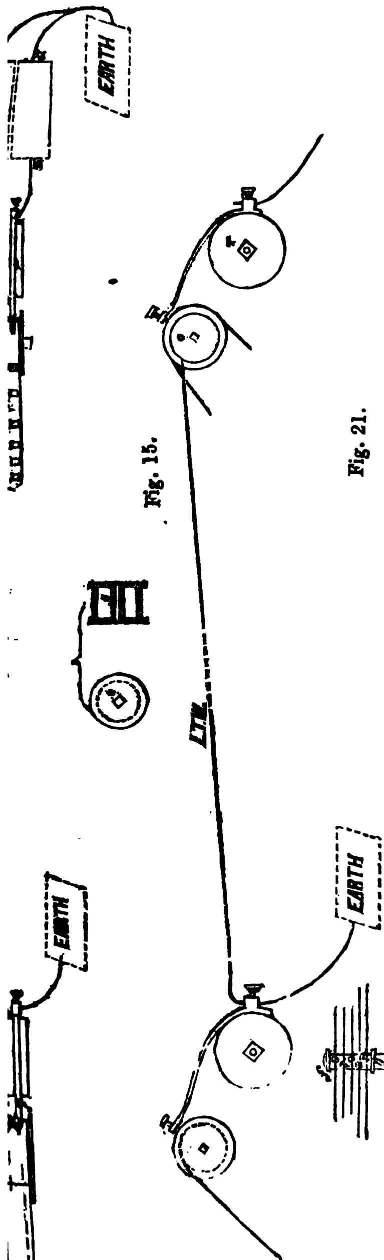


Fig. 15.

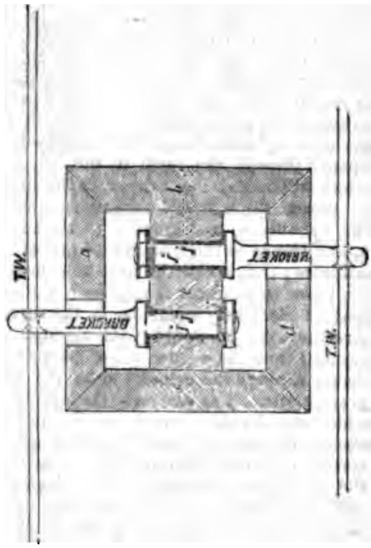


Fig. 21.

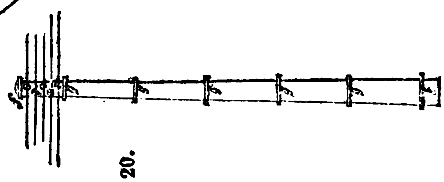


Fig. 20.

r would only have two springs *t* and *v*, and the perforations in the paper would be cut so as to come under the point of only one of these springs, and the spring *t* would be in connection with the copper end of one battery, and the spring *v* would be in connection with the zinc end of the other battery, the opposite ends of each battery being by a branch wire connected with the earth. The telegraphic wire being in connection with the cylinder *o*, which, in this case, will be a simple cylinder of metal, the receiving end of the apparatus would be fitted or arranged as before. The apparatus is shown in the position of having a perforation in the paper under the point of the spring *v*, by which means the circuit will be opened through the earth to the spring *q*, which will make a mark thence to the spring *p*, thence through the telegraphic wire to the cylinder *o*, and from it to the spring *v*, and thence to the zinc end of one of the batteries; and, in case the next hole through the paper come under the spring *t*, the current of electricity would be in the reverse direction; for it would pass through the spring *t* from the copper end of its battery, thence through the cylinder *o* to the telegraphic wire, then through the spring *p*, which would make a mark on the passing chemically-prepared paper, then through the spring *q* to the earth, and by the earth to the zinc end of the battery. Two telegraphic wires, kept well insulated from each other, may be used in transmitting and receiving communications, as shown at figs. 16 and 17, which figures show a plan and side view of so much of the apparatus as will enable me to explain this arrangement. In this arrangement the barrel *o* would be made of two parts, insulated from each other, and one of the telegraphic wires would be in connection with one part at one end, and also with the spring *p* at the other end; and the other telegraphic wire would be in connection with the other part of the cylinder *o* at one end, and also with the spring *q* at the other end; and the cylinder *o* at the receiving end of the apparatus would, by a branch wire and spring, be in connection with the earth: the springs *t*, *v*, at the transmitting end of the apparatus, would be in connection with one end of a battery at A, the other end of the battery being in connection with the earth. The perforated paper in this case is like that last described, the perforations only coming under one of the springs *t* or *v*, and the electric currents will pass through the paper to the barrel *o*. The direction of the currents in this apparatus will readily be traced as they pass from the battery at A to one or other of the springs *t*, *v*, and thence through one or other of the electric wires to the sp[...] and thence to the earth, and from t[...] to the other end of the battery. I [...] thought it necessary to enter into [...] scription of the means of giving si[...] alarms or otherwise, between distan[...] where my invention, as herein de[...] may be applied—the same forming [...] of my invention.

And I would state that my a[...] may be used separately from oth[...] trical telegraphs, or may be used [...] junction with other electrical tele[...] which latter may by some be consid[...] most preferable, as all communicati[...] not required to be written and r[...] And I would state, that in some ca[...] ties may be desirous of receiving the [...] communication in such a state tha[...] could not read it, in which cases it [...] be necessary to saturate the paper [...] solution of sulphuric acid, and de[...] paper (after it has received the [...] written communication from the co[...] dent at a distance) to the party in th[...] when the party receiving the pa[...] bring out or render visible the wri[...] subjecting the paper to the other pa[...] solution above mentioned; and sh[...] paper not be delivered to the part[...] apparently unmarked state, he wi[...] that the paper has been acted on imp[...] between receiving the communicati[...] it and its being transmitted to him. [...] manner an apparatus may be arra[...] working, with only one marking p[...] one transmitting point, as shown at [...] and 19, which show a side view an[...] of so much of the apparatus as wi[...] by the description already given, [...] person at once to understand this [...] ment. It should be stated, that in [...] the receiving cylinder *g*, as show[...] simple cylinder of metal. The card [...] No. II. shows a suitable arrangement [...] for this apparatus.

Mr. Bain's specification gives [...] following description of a mode [...] structing the posts or uprights fo[...] ing the telegraphic wires:

Fig. 20 shows a post, or uprig[...] structed according to this part of m[...] tion. Fig. 21 is a transverse sectio[...] same, full size. The object of the i[...] is to make the posts of several pieces [...] together, and combined by cast-iro[...] which will have a tendency to des[...] any shrinkage taking place. Th[...] shown is made of four pieces, *a*, [...] which, separately, are comparative[...] and thin, but, framed together, as [...] are stiff and firm. *e* is a stro[...] piece of dry wood, fixed at the upp[...]

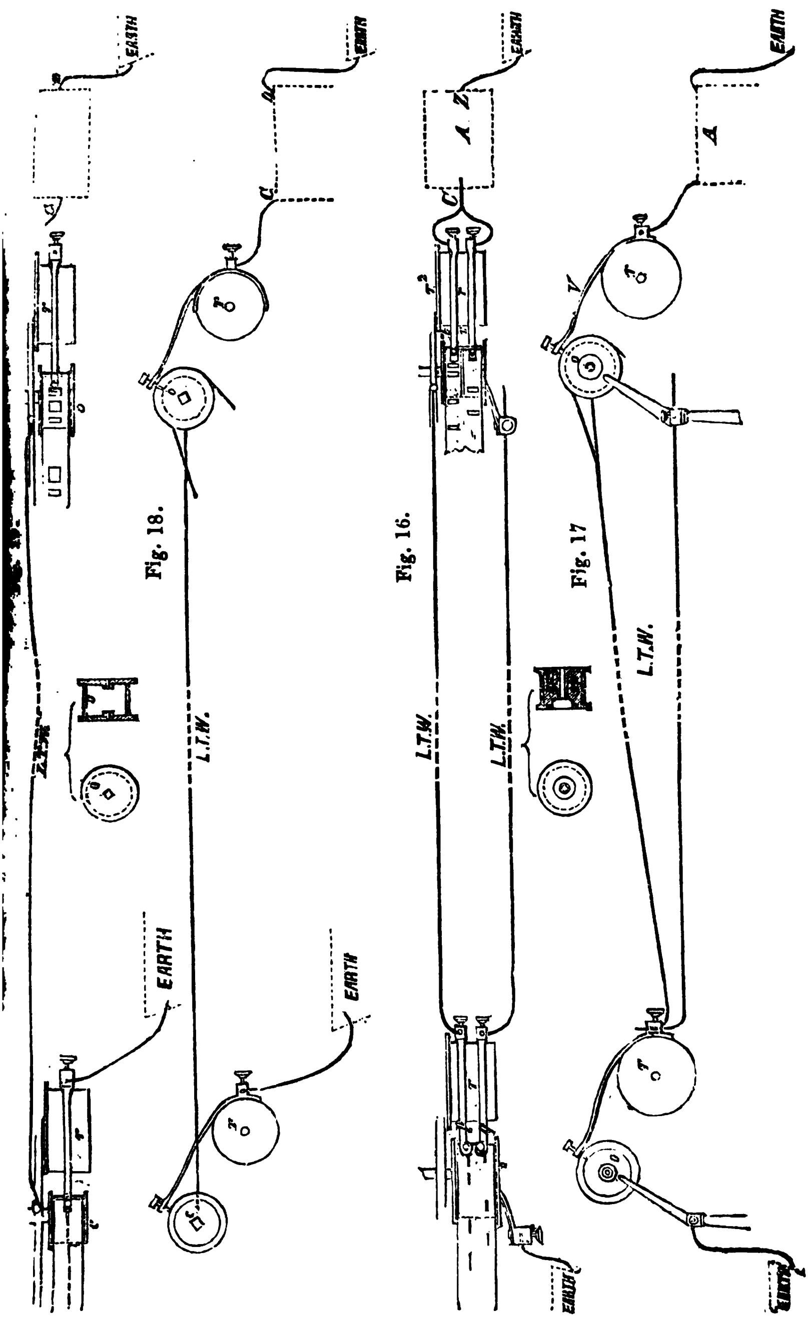


Fig. 19.

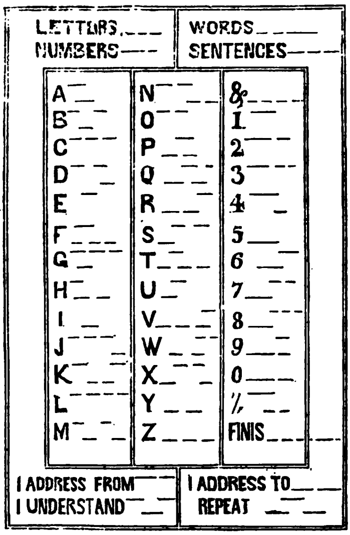
Fig. 18.

Fig. 16.

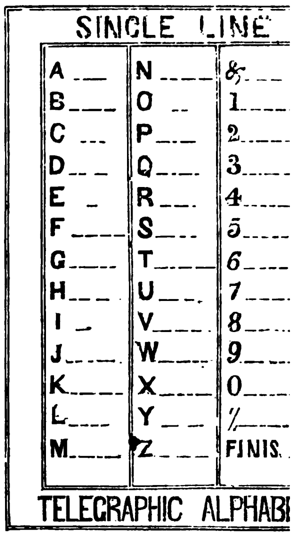
Fig. 17

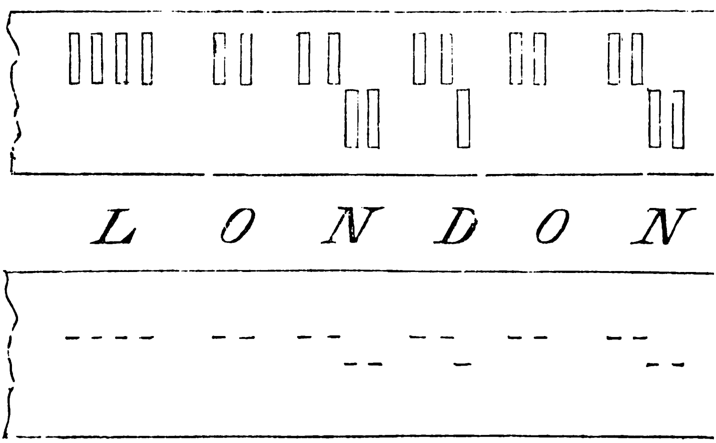
of the post or upright, into which the various brackets are fixed, as is shown, there being washers *i*, and tubes *j*, of India-rubber, or other suitable non-conductor of electricity, to keep the metal brackets insulated; and at the upper part is a cap *f*, which covers the upper part of the post;—and thus is the whole interior kept ‹ are the cast-iron hoops which bind t of the parts together; and, as the larger at bottom than at top, any s will not injure the stability of the the hoops will descend, and retain secure.

No. I.



No. II.





Claims.—Having thus described the nature of my invention, and the best means I am acquainted with for performing the same, I would have it understood that I do not confine myself to the details, as herein described, so long as the peculiar ch of either part of my invention be re But what I claim is, FIRST—The n arranging and combining apparat transmitting and receiving electrica

graph communications, whereby mechanically-composed communications are transmitted through electric circuits, and are received by chemically-prepared surfaces—both apparatuses being kept in motion by mechanical means, without the aid of magnets, thus avoiding the comparatively slow process heretofore consequent on the making and unmaking of electro magnets at each time of producing a mark. And also I claim the mode of arranging electric apparatus so as to obtain two separate and distinct marks or signs by one electric circuit, as herein described.

And, SECONDLY—I claim the mode of constructing posts, or uprights, for supporting telegraphic wires for electric telegraphs, as herein described.

AMERICAN PATENT LAW CASE.—PLANING, TONGUEING, AND GROOVING MACHINERY.

[We copy from a late No. of the *Eureka* of New York the following judgment delivered by Judge Kane in a case *Smith and Sloat* v. *Mercer and Pechin*. We do so for two reasons: first, the great ability displayed in the judgment—which will bear a comparison with the best patent decisions of the judges of the mother country; and, second, for the clear light that it throws on a branch of mechanics of great and universal interest. ED. M. M.]

The Judgment.

Smith and Sloat v. *Mercer and Pechin.*

His Honour JUDGE KANE.

This case came before the court on bill and affidavits, upon a motion to restrain the defendants, by special injunction, from constructing, selling, and using Woodworth's planing, tongueing, and grooving machine, or any of the parts or combinations thereof.

It was very fully examined and ably argued by the gentlemen who are of counsel in the several cases growing out of Mr. Woodworth's patent right; and it was agreed that the evidence adduced in the case of Sloat and Plympton, which was considered immediately after this, should be applied to both cases.

The facts, so far as they are undisputed, are these:

On the 27th December, 1828, letters patent were issued to William Woodworth, of Troy, in the State of New York, conferring on him exclusive property of his "Improvement in the method of planing, tongueing, grooving, and cutting into mouldings, or either, plank, boards, or other material."

The patentee having died on the 9th of February, 1839, letters of administration on his estate were duly granted to his son, William W. Woodworth, by the Surrogate of New York, at which place the father was residing at the time of his death.

On the 29th July, 1842, the administrator applied for an extension of the patent for seven years: and the Board of Commissioners, to whom the application was referred, under the act of 1836, having certified in his favour, the patent was extended in the name of the administrator as such.

On the 8th July following, the administrator surrendered his letters patent, in accordance with the provisions of the 13th section of the act of 1836, for the purpose of obtaining a renewal upon an "amended specification, describing the invention in more full, clear, and exact terms," and the amended patent issued to him on the same day, under the hand of the Secretary of State, countersigned and sealed with the seal of the Patent Office, by "Henry H. Sylvester, acting Commissioner of Patents."

The complainants claim, under a grant of the exclusive right within and throughout the county of Philadelphia, made by the administrator, on the 29th November, 1842, and duly recorded.

It is admitted, that the defendants, Plympton and Hogeland, have been using, and they claim the right to use again, a machine, known as Ira Gay's, which effects the same purposes as Woodworth's, and which is alleged by the complainants to be in principle and substantially the same.

Upon these facts several preliminary questions have been discussed by the counsel for the parties, which I shall briefly consider.

1. It is said, that the administrator had no power to surrender the patent of 1828, after assigning exclusive rights under it, and that the new letters patent, being founded on such surrender, are void.

It is not easy to see how this objection, if valid, could affect the case before the court. The complainants do not claim under the new letters patent, but under the old; and these cannot have been invalidated by an unlawful surrender of them.

But it seems to me a mistake to regard the complainants, or any other persons whose rights have been brought to the notice of the court, as assignees within the meaning of the patent laws. There are four classes of persons recognized by the 13th and 14th sections of the act of 1836, as parties "interested." These are the original patentees, their executors or administrators, their assignees, and the grantees under them of the exclusive right for a specified part of the United States. These last, by the express

words of the 14th section, have the same rights of suit as the patentee or his assignees: and it is by force of this that the complainants, who are merely grantees of a limited right, are admitted as parties here. But they have no power over the letters patent: these remain with the party to whom they were issued, or the general representative of his interest; and the power of surrendering them for amendment and renewal is vested exclusively by the 13th section in the "patentee, his executors, and administrators, or the assignee of the original patent." The administrator, therefore, upon the facts disclosed, was the only person who could make the surrender and receive the amended patent; and there is nothing in the act of Congress which restricts his right to do so, because of his having previously made special or limited grants or licenses.

2. It is said, that the amendment of the specification, as made upon the re-issue of the patent in 1845, do not enure to the benefit of the assignees or grantees under the patent, as it stood before; in other words, that they must stand or fall with the original specification.

I cannot assent to this. The complainants are not grantees of the patent, or any part of it: they are grantees of certain rights, of which the letters patent are the evidence and definition. If those rights are made more clear and definite (not more extensive) by any new or additional act whatever, from whomsoever proceeding, why shall the complainants be denied the advantage of using that clearer and less equivocal evidence?

This is not the case of a surrender and re-issue with amended specification, where the grantee for a district prefers resting his claims on the specification as it stood when he purchased his right. As where the patentee makes a disclaimer of part of the invention, the prior grantee might in such case refuse to be affected by it. But here the objection comes from third persons: the complainants adopt the amended specification, by making it part of their bill; and the only inquiry is, as to their authority for doing so. The question is settled as to third parties by the provision of the act, that the amended specification shall have the same effect and operation in law, on the trial of actions, as though it had been originally filed in its corrected form.

3. The 5th section of the act of 1836, directs that all patents shall be issued under the seal of the patent office, and be signed by the Secretary of State, and countersigned by the Commissioner: it is argued that this patent is invalid, because signed by an *acting Commissioner.*

Mr. Sylvester, the countersigning was the chief clerk of the Patent the time; and as such, by the word 2nd section of the act, in all cases the necessary absence of the Commi or when the principal office became had the charge and custody of t records, and other things belongin office, and was required to "perf duties of Commissioner *during s cancy.*" It is contended by the co ants, that the words "during such va apply as well to the case of the n absence of the Commissioner as to the commissionership being vacant b resignation, or removal.

This may be a grave question. I prepared to say, that the absence Commissioner, while he retains his character, constitutes a vacancy in th or that the inferior officer can succe exercise the powers of the principal while that station has a lawful inc But I do not regard the question as before me, at least at the present the cause. I recognize the signatur Secretary of State, the public seal Patent Office, and the counter sign a person who has the custody of it the absence of the principal commi and the right to use and attest it in a contingency. I find him designa official character for the time, by wo imply his legal substitution to the question. There is no allegation of usurpation on his part: on the contr act is sanctioned by the commission acting in person.

It would be too much for me, in a locutory proceeding like this, to d validity of these letters patent. I am rather to adopt for the time the lang Judge Story (in the case of Woodw Stone, 1st Circ. May T. 1845), on tion not unlike the present, and t counter-signature, as he did the re-i the patent, "to be a lawful exercise officer's authority, unless it is appa the very face of the patent that he ceeded his authority."

4. It is contended that the grant right under letters patent cannot ma suit in a circuit which forms part of sylvania, if he derives his title th foreign administrator.

This idea refers itself to the lo of Pennsylvania, which, as it seems have no application to the case. By of 1836, "*all* actions, suits, contro and cases" whatever, arising under tent laws, are without any exception nally cognizable in the courts of the States; and it has been held in t

which the question has arisen (Par- Barnard, 7 Johns. 144), that this ion is exclusive. The right which . by letters patent, has its origin in nt laws, and is transferable and sible according to their provisions. leath of the patentee in this case, it nder them to his administrator; and a personal right, the administrator ed by the forum of the domicil be- ble to account for it. If the right since violated, he may sue for in his own name, as for a wrong to ssion: if he has sold it in whole or he may recover the price in his own for a breach of contract with him- rier v. Huston, 8 S. & R. 402, erger v. Bucher, 10 S. & R. 13.) doubt, therefore, that William W. rth, the administrator, to whom the tent passed upon the death of the , might himself have maintained an the Circuit Court for a breach of nt right, without taking out new administration in Pennsylvania.

ess can I doubt the power of this interpose by injunction in such a prevent an intended violation of It would be almost equivalent to a epeal of the letters patent upon the the patentee, to affirm that the g action of the courts shall have tion beyond those of the twenty- thirty States in which the patentee ented by local administrator.

ere the law in this particular other- as I believe it to be, it is by no ue that the incapacity of a foreign rator to sue implies the same con- o his alienee. On the contrary, it expressly declared by the highest urts, that where a plaintiff's title is through a foreign administration, it asserted in a judicial proceeding hout constituting a domestic admi- . (Trecothick v. Austin, 4 Ma. Harper v. Butler, 2 Pet. 239).

good deal of evidence was adduced that the amended specification de- a different improvement from that embraced in the original patent; as argued, that the amended patent lidated by the variance.

however, on the authority of Judge a case affecting this very patent orth v. Stone, *ut supra*), I do not s open to question at this time. "It to me," he said, "that prima facie, ll events in this stage of the cause, it taken to be true that the new patent e same invention as the old patent; the only difference is, not in the n itself, but in the specification of * * * For the purpose of the injunction, if for nothing else, I must take the invention to be the same in both patents, after the Commissioner of Patents has so decided by granting a new patent."

Though thus relieved from the necessity of passing upon the question, I feel bound to remark, that the evidence has not satisfied me of the fact it was intended to establish. The very title of the patent, in the words of the inventor, "his improvement in the method of planing, tongueing, and grooving, *or either*," and the expression in the body of the specification, that after the planing is completed, the tongueing and grooving apparatus is to be used "*if required*," indicate to me that the patentee had in his mind from the first, a machine of several parts or systems, which could be used separately or in combination, as his administrator has developed more fully in the amended specification. So, too, his omission to declare in the first specification, that he employs rollers for retaining the board in its place while planing, though fully set out in his amended specification, cannot, in my view, support the idea that the inventions described are not essentially the same. The rollers, which he refers to in the first specification, and which are more unequivocally shown in the drawing annexed to it, as giving motion to the board, would almost necessarily perform the double office: besides which, there are other devices well known to mechanics, which could be conveniently adapted to the object. I see nothing in the two specifications which could justify me in referring them to different machines.

These preliminary objections being disposed of, three questions present themselves:

1. Was William Woodworth the inventor of the machine, for which he obtained letters patent in December, 1828?
2. Has he had, since the issuing of the letters patent, such an exclusive and continued possession under them; or have his rights as patentee been so vindicated by judicial action, as to claim for him the summary intervention of equity at this time for his protection and repose?
3. Is the machine now made or used by the defendants the same in principle and substance with the machine so patented, or with any material and distinguishable part of it?

1, 2. The two first of these questions have been so often decided in the Circuit Courts of the United States, as to dispense with the consideration of them at this time. In the case of Van Hook against Scudder, in the Circuit Court for the Southern District of New York, in 1843; and in another

case in the northern district of the same state; in that of Wilson *v.* Curtis in the fifth circuit, Louisiana district; in Washbourn *v.* Gould, in the first circuit, before Judge Story, at May term, 1844; and in twenty other cases decided summarily immediately afterwards by the same judge; and again, in Woodworth *v.* Stone, at May term, 1845;—in all of these, and in numerous other cases which have been alluded to in the arguments, the Woodworth patent has been recognized as valid, and the claimant under it as entitled to protection by injunction.

Two cases only have been mentioned, as implying a different opinion. The first is that of Woodworth *v.* Wilson, in the Circuit Court for Kentucky, where an injunction which had been granted was dissolved after more full hearing. But in this case the decree dissolving the injunction was reversed by the Supreme Court at its last session, and a perpetual injunction directed.

The other case is that of Richards *v.* Swimley, on the Equity side of this court, No. 1, of April sessions, 1841, in which Judge Hopkinson is supposed to have refused an injunction to claimants under the Woodworth patent, against a person who used a machine closely resembling that of these defendants. But an inspection of the record shows the supposition to be mistaken. The bill in that case was filed on November 4, 1840; and notice was given of a motion for an injunction, to be made of the 14th. On that day the complainants filed two affidavits, which defined the infraction to consist in the use of Woodworth's tongueing and grooving apparatus, making no mention of the machinery for planing. It does not appear that the motion was ever heard; and on the 16th, two days after the time noticed for making it, it was withdrawn by the complainants; since which no proceedings have been had in the cause. The right of the complainants in the machine expired in 1842. No judicial opinion on the part of Judge Hopkinson can be inferred from these facts; and I am left therefore to the concurrent judgments that have been pronounced in other circuits.

I may add, that my own very careful examination of the different inventions that are supposed to interfere with Woodworth's has not led me to a different conclusion from that which a proper judicial comity invites me to adopt.

3. The only remaining question is that which regards the substantial identity of the machine used by the defendants with that patented by Woodworth.

The patent of Woodworth, as defined in his amended specification, is for a machine, *capable of performing the operations of* planing, tongueing, and grooving, at one and the same time, but which admits of their being performed separately. It consists essentially of two parts or systems; one for the planing or smoothing the surface; the other for fashioning the tongue and groove upon the edges.—The apparatus for feeding the machine, and the rollers by which the elastic material is held firm while undergoing its action, are subsidiary to these.

I shall consider the two systems of machinery in succession.

1. The planing machine.

A practically smooth surface may be given to plank or other substances, by the application of either of three forms of tools:—the chisel, which, with a gauge to regulate its action, becomes the ordinary plane; the drawing-knife, which, with a similar gauge, forms the spoke-shaver, and the adz. Each of these has its appropriate or characteristic motion; though by the ingenuity of the workman, the motion of either of them can be modified so as to approach that of another.

The chisel, when in the form of the plane, has its blade fixed at an acute angle with the surface to be reduced, and works parallel to that surface, the edge cutting generally at right angles.

The gauged drawing-knife differs from the plane in this; that by means of its two handles, its edge can be made to cut obliquely, or at right angles, at the pleasure of the workman. Its general motion is parallel to the surface; though being more under control of the hand; and having its blade sometimes slightly arched, it may be made to deviate upwards or downwards, with a varying angle, or in a curve.

The adz has an arched edge, and cuts only in curves; the level surface being attained proximately by a succession of such cuts.—The plane and drawing-knife operate by shaving the surface, the adz by chipping.

The chisel-plane was combined with apparatus for giving it motion and direction, in the machines of Bentham, in 1791, Bramah in 1802, and Muir of Glasgow in 1827. In the first and last of these, the character and direction of the motion were those of the same tool when worked by hand. In Bramah's, the planing blades of iron were fixed upon a revolving disc; the character of the motion thus becomes circular, but still continuing to be parallel with the surface.

The planing machine of Woodworth, though it uses knives or cutters resembling plane irons in form, is essentially a series of adzes. These are attached to the outside of a cylinder, in lines either parallel or oblique to its axis; and as the cylinder re-

hey cut with an adz-like or dubbing the knife, which is parallel to the senting its whole edge to the plank ame moment, and in this respect ike the plane; the knife which is or in the helix form, presenting the the edge in succession, and in this utting like the drawing-knife; but ms of knife cutting in vertical ike the adz, not in plain surfaces chisel-plane, and its combinations am, Bramah, and Muir.

ling, then, the Woodworth machine ntially different from the three last d, I find the substantial difference t in this, that they act in planes o the surface to be removed, Wood- n vertical curves; that theirs pro- absolutely level surface, his a sur- rently level, but in fact corrugated d.

tongueing and grooving machine. lea of tongueing and grooving by ions of the circular saw is at least 1793, when it was described by Bentham, from whom Muir copied ine many years after. The speci- f the two concur in describing a olving saw, or cutter, to make the and two wheel-saws set at right ith each other on each side the aking four in all, to cut the rebates ongue. The machine of Wood- an improvement on these, by sub- a single firm cutting wheel for the lar tongueing-saws, and combining the equally firm grooving cutter on edge of the plank, to reduce it to y equal width throughout.

not see an essential difference be- e grooving cutter in this machine, circular saw, or cutter, described am and Muir. But their tongue- ratus is clearly not the same as rth's; and I doubt very much the tongueing and the grooving practically combined in their ma- ith the same effect as they are in y certainly are not.

two systems of machinery, the and the tongueing and grooving, me to constitute the essential, and sential, parts of the Woodworth nent. The amended specification hem, in the several combinations of ey are susceptible, as follows:

e employment of the rotating planes ination with the subsidiary rollers, alogous device:

e combination of those planes with eing and grooving wheels:

e combination of the tongueing with ring apparatus:

e combination of *either the tongue-* ing or grooving wheels with the rollers, which by their pressure hold the plank steady in its place.

Having thus analyzed the patent right under which the complainants claim, it remains to determine whether the machine used by the defendants is in part or in whole substantially the same.

And 1. Of the planing machine.* an absolutely plane surface, it loses one of the characteristics of his machine.

On the other hand, it is clear, that a machine, sensibly like Woodworth's, may not exactly conform in its structure to the rigid definition of a cylinder. The smallest change of diameter between the two ends of the revolver, on which the planing knives are placed, would convert the cylinder into the frustrum of a cone; and a corresponding inclination of the axis of motion, or a corresponding adjustment of the plank to be acted on, would make the machines operate as well, or nearly as well, as if the exact character of the cylinder had been retained.

Yet, just in proportion as the sides of the Woodworth revolver approximate to a cone, the machine approaches the planing disc of Bramah. It ceases to cut as the adz merely, but takes in some degree the characteristic action of the chisel-plane and drawing-knife.

So, too, when you give a *dished* form to the disc of Bramah, thus converting the disc into a cone, you lose in part the characteristic action of the chisel-plane and drawing-knife, and introduce in the same degree the appropriate motion of the adz.

This deviation from the strict form of the Woodworth machine towards that of the Bramah, or from the Bramah towards the Woodworth, may go on increasing, till the appropriate action of the original machine effectively disappears; the cylinder, by a series of progressive changes, having lost itself in the disc, or the disc in the cylinder. It is impossible to define, for the practical objects of a judicial decree, that angle or degree of deviation at which one of these geometric forms shall be said to pass into the other.

Between the two machines, then, the Bramah, unprotected by a patent in this country, try, which cuts parallel to the surface with a planing motion, and the Woodworth, which cuts with the dubbing action of the adz,—where is the line of separation? Obviously, it is at the point of the first deviation from the free machine to that of which the use is prohibited.

Turning now to the machine used by the defendants, we find it to be a revolving cone,

* *Sic* in the judgment as given in the Eureka, but there is evidently some omission here.—Ed. M. M.

its axis or spindle so arranged as that the tangent plane of its curve shall coincide with the surface to be made smooth. It partakes of the disc character, and cuts as the drawing-knife and chisel-plane also; but just so far as it varies from the simple disc of Bramah, it embraces the principle of Woodworth's machine, by involving the dubbing action of the adz. It cuts as the drawing-knife, and the plane, while approaching the point at which the knives act upon the finished surface, and its cutters continue to revolve with a similar motion after passing that point; but at the effective moment, it is not the plane or the draw-knife, but the adz cut, that furnishes the work.

Much stress has been laid upon the fact, that the knives in the defendants' machine are not in the lines of the radius, but have a certain obliquity, which brings one part of the edge in contact with the board before the rest, and gives a sloping or drawing action, not unlike that of the pocket-knife while cutting a stick. But I see nothing in this action or arrangement to distinguish it in principle or substance from that of the Woodworth rotary cutter, when placed in the oblique line of the helix. Whether it be the knife that moves in part lengthwise during its revolutions, presenting the points of its edge to the board in succession, or the board, which, moving onwards, presents its face to the several points in succession of the knife edge, or whether the action results from the combined motion of the two, the machine and its mode of operation are substantially the same.

I am therefore of opinion that the planing machine of the defendants is an infringement of the complainants' patent right.

2. As to the tongueing and grooving machine.

This part of the machine in use by the defendants does not vary sensibly in : character from the tongueing and g: apparatus claimed by Woodworth. his patent shall be invalidated, he has to claim of this court the protection restraining process in regard to this :

It is my duty, therefore, to grant injunction as prayed for. In doing s not insensible to that which was : pressed in argument, that if I am ii the respondents may be seriously prej But the court can seldom encounter that does not involve a similar respor for consequences. To withold judicia is not to escape from this. The rig party to the most speedy and effectu tection against a meditated wrong, is complete as his right to his redress for already inflicted: and the accident o tion confers no right on one party, v he be plaintiff or defendant, at the e of the other. The special injunc equity, like the arrest on mesne pro the law, may be abused to the injur opponent; but it is no less on that : the duty of the judge to further ther when, in the exercise of his best dis he believes that they are called for merits and the exigency.

This is a case of an ancient and important patent-right. It has bee tested at law and in equity with an ness and pertinacity proportioned value. Yet, during the lifetime of ventor, eleven years, it was "never s fully impeached." (Story, J., in bourn v. Gould.) There is here no a cence, no laches; but, on the contr promptness and vigilance.

I accordingly direct a special inj to issue according to the prayer of t and to remain until the hearing of the or the further order of this court.

EXPLOSION OF AN AMERICAN LOCOMOTIVE—REPORT OF A COMMITTEE OF T FRANKLIN INSTITUTE ON THE CAUSES OF THE ACCIDENT.

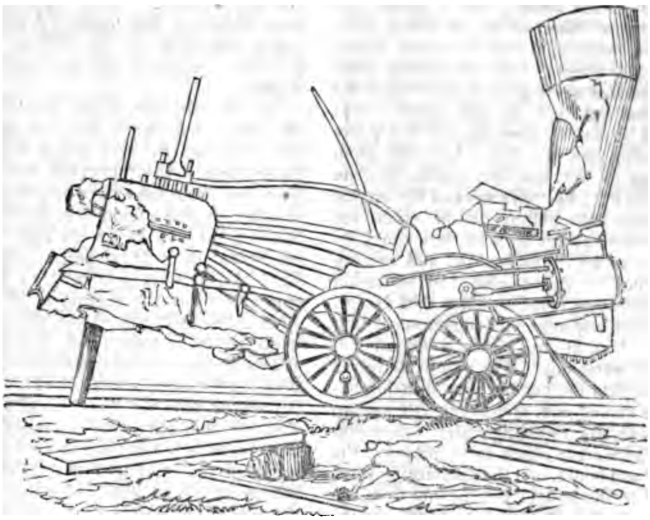
The Committee on Science and the Arts, constituted by the Franklin Institute of the state of Pennsylvania, for the Promotion of the Mechanic Arts, to whom was referred the examination into the causes of the explosion of the locomotive engine "Neversink," upon the Reading Railroad, on the evening of the 14th of January last,

Report,

That they have collected all the evidence bearing upon the subject which they could obtain, and have visited Reading for the purpose of examining the wreck of the engine. The following is the result c inquiries :

The engine "Neversink" was ally built by Baldwin, and sent up road in April, 1836. It then weigh tons, and had six wheels, two of whic drivers. The engine was thorough newed, and rebuilt by the Reading R Company, at their Reading depôt in 1846, and was changed to an engine tons, on six wheels, all connected dri

In rebuilding it, four plates in at the fire-box end of the cylindrical



were retained, and $1\frac{1}{2}$ sheets in
re added at the front end of the
The new iron was $\frac{5}{16}$ths of an
ickness, the old one-fourth of an
e vertical part of the boiler was
in diameter; the fire-box was 39
g, 37 inches wide, and 44 inches
crown was stayed with wrought
e bars, and was so strong that it
no damage from the explosion.
ontal portion of the boiler was
s in diameter, and 11 feet 6
length between the tube sheets.
e-box was 2 feet 3 inches in depth,
total length of boiler of 18 feet.
e 128 wrought iron tubes 2 inches
l diameter, and one-eighth of an
t in the wall; they had copper
e fire-box tube sheets.
was but one safety valve, $2\frac{1}{4}$
diameter, placed upon the dome;
four gauge cocks, the lower one
was 8 inches above the crown-
the upper one about 14 inches
lower.
ghest tube was $1\frac{1}{2}$ inch below the
the fire-box, and $11\frac{1}{2}$ inches below
the cylindrical part of the boiler.
re surface reduced to fire-box
nounted to 309 square feet.
inders were $13\frac{1}{2}$ inches by 20.
g wheels 46 inches in diameter.
favourate engine upon the road,
run, previous to alteration, in

6	71,010 miles.
rds	18,041 ,,
Total	*89,051 miles.*

Upon their examination, the committee found the horizontal part of the boiler almost completely destroyed. In this part of the boiler the explosion had manifestly originated, commencing in the older iron which remained in the hinder part of the boiler. The tubes were, for the most part, still fast in the tube-sheets, but they were bent outwards at their middle, like the staves of a barrel. The steam-pipe, as it passed through the boiler, was *collapsed*, but not broken. The outer shell of the boiler had been torn into fragments, and the rents had extended to the vertical part, the upper portion of which had been entirely torn away, so as to expose the fire-box, which was sound, but slightly caved in on the sides. The cylinders were unharmed by the explosion, but had since been removed. The quality of the iron appeared to the committee to be uniformly good.

There was, therefore, nothing about the engine to indicate that the accident had occurred from defects in workmanship or material, nor, indeed, did the tremendous power which was indicated, seem consistent with the idea of an originally defective boiler.

Through the kindness of the Railroad Superintendent, the committee had an opportunity of examining Patrick Fagan, the engine driver usually in charge of the "Neversink," whose testimony is in substance as follows, viz.:—

That, when in the hands of a driver who understood it, the "Neversink" was the best engine he ever knew, but that no one who did not understand the engine, could tell, by the gauge-cocks, how much water

there was in the boiler; that it would frequently throw water out of the safety-valve when the water-level was, in reality, below the second gauge; that the pumps were good, and had never given trouble when the water-level was kept up, and could always be made to act by opening the fire doors and cooling the fire down, but that when the water is low, and the engine hot, no pump will act; he "has worked the engine when, with both pumps on, he could not get the water up for an hour, but could always do so by running slow, and cooling the engine." Has carried 150 lbs. steam upon the engine, (the steam was then damp), but believes any engine is dangerous at that pressure, "as at that heat, a second will throw the water out." The pumps delivered the water into the boiler about 6 inches behind the smoke-box, and about half way up the tubes; the receiving valve was under the cylinder; the check valve between the cylinder and boiler, and the discharging valve close up to the boiler: the distance from the receiving to the check valve was about four or five inches, and about 20 or 24 inches from the check to the discharging valve. The engine was at this time in perfect order; had been brought down by the witness on the preceding Tuesday, and had laid over until Thursday night, when the witness went to the depôt for the purpose of taking it up again, but was recalled by a message from his sick wife, and the engine was entrusted to Jacob Salleburger, under whose charge it was when it exploded.

In reference to the behaviour of the engine, Mr. Kirk, the foreman of the shops of the Company at Reading, remarks, that he was not aware of any peculiar difficulty about the "Neversink," but that "all our large class engines are a little ticklish in carrying water." The cause of this we shall presently endeavour to show.

The accident occurred about 30 yards above Mill Creek bridge, and the watchman upon the bridge gives the following account of what he saw and heard:—

He was standing in front of his door when he heard the engine coming, and, as it approached, he noticed the peculiar loudness and sharpness of the exhaust; the engine was then running very fast, and was not blowing off steam. As it passed the bridge, one of the persons upon the platform was stooping down, apparently looking in at the fire doors, and as he rose, he put his hand either upon the safety-valve or upon one of the stays; almost immediately afterwards, the witness heard a very loud roaring like thunder, which he is sure was not the escape of steam from the safety-valve; this lasted about thirty seconds, when the explosion took place, by which he was knocked down, and saw no more; when he got up immediately to the engine, but was gaged attending to the sufferers, paid no attention to the appearanc engine.

Mr. Nicolls, Mr. Kirk, and Mr. all testify that, when they saw the next morning, the broken ends of th as far down as the fourth row from were blue from the effects of overhe member of the committee, howeve was on the ground at the same ti clares that he could not perceive this, he looked for it particularly; wl committee saw the engine, at Rea such appearance was visible, nor co expected, since a snow fell on the the accident, and subsequent oxidatio destroy all traces of the colour.

Neither did the fire-box give a servable indications of an exposur unusual heat. Yet there is no doub minds of the committee that the wa proper supply of water was the pr cause of the accident.

The evaporative power of these engines is necessarily very great Nicolls assured the committee t "Neversink" was capable of drawing of 88 cars, weighing, loaded, 7¼ ton (equal to 637 tons), at a speed of 1 per hour. (1056 feet per minute). ing the traction to be 7½ pounds p (as experiments upon this road to be), this is equivalent to 153 power—requiring an evaporation cubic feet of water per minute.

Now, by the peculiar construction engines, rendered necessary by the re space allowable for the boiler, wl water-level stood 2 inches above th cock, the steam was confined exclus the hemispherical dome above the fi the cubic content of which is rath than 24 cubic feet (23·8565 cubic fee cubic content of each cylinder (13·5 1·657 (1⅝) cubic feet, and, as two cy are drawn at once, the ratio of the c cal content is as 3·314 to 24, or mo one-eighth. When the water-level i upper gauge-cock, the steam room cubic feet, and the ratio about on Now, the most recent (and appare best) authority upon the high press gine declares, after nearly 30 years tical experience, that "the steam should be at a minimum 20 times a as the space to be filled with stea cylinder. If it can be made great sistently with the other arrangement boiler, so much the better."* Thi course, inapplicable in locomotive e

* Alban, on the high pressure engine, p.

e reason, therefore, that these engines hrow water from the safety-valve, and the gauge-cocks, when the actual ·level is dangerously low—and that, words of Mr. Kirk, " they are ticklish rying their water"—must be evident. ıaming in one of these engines must :essant, and the danger of priming reat. The gauge-cocks, which, under ıst favourable circumstances, are but rent indicators of the water-level, ı, in this case, useless, and the engine must rely upon his experience of the , and trust to incessant watchfulness if he would avoid an accident.

ıry remarkable fact about this explo-, that the steam pipe passing through per part of the boiler, from the throt-ıe to the cylinders, was *collapsed* and , as will be seen in the accompanying reotype portrait of the engine, taken he explosion by Mr. David Monday, ding, and kindly lent by him to the ttee. It is, indeed, possible that this ave been produced, during the ex-ı, by the sudden bending upwards of e, otherwise it would seem to indicate e engine was throttled at the time of losion; an expedient which may have sorted to for the purpose of avoiding pness of the steam, or to check the of the engine; but the fearful danger will be seen when it is considered f the steam was shut off but one- (the water being above the lower ock), the pressure in the boiler would itself in about one minute.

ems useless to speculate upon the iate cause of this terrible accident he death of all upon the engine has d the direct testimony of the circum- under which it occurred, except that watchman before referred to. From dence, however, it appears that the was under a very unusually heavy pres- steam, and scarcely less certain that ety-valve was (accidently or other- stened down.* Mr. Nicolls and Mr. oth testify to the compentency of the driver who was in charge, and every ars witness to his character for so- That he may have been deceived as ıeight of water in the boiler is pos-om the character of the engine, al- it is difficult to imagine how an ex- ed hand could heve neglected the ons given by the increased pressure, m by the rapid running of the train, ; sharpness of the exhaust.

Dr. Alban, in his recent treatise upon the high-pressure engine, before referred to, mentions a rumbling noise as often preceding explosions, and attributes it to the sudden loosening of the scale upon the boiler, and the increased access of water to unduly heated metal thus produced (p. 18). But the scale upon the tubes of the "Neversink" was not thick enough to produce any effect of this kind, nor does it appear to have been loosened to any extent. It seems, therefore more probable to the committee that the roaring noise referred to by the watchman as preceding the explosion, may have been caused by the starting of one or more of the tubes at the forward end, and the consequent escape of the steam into the smoke-box, the sudden diminution of pressure consequent upon which, would cause the rise of water in foam over the heated tubes, and thus almost instantaneously produce a pressure which no locomotive boiler could withstand.†

Upon the whole then, it appears probable to the committee that the explosion of the "Neversink" occurred in this way :—

That the engine was running under a heavy pressure of steam, and that, owing to the defective indications of the gauge-cocks, the water in the boilers was permitted to get below the upper tubes, which thus became unduly heated: that the rapidly increasing pressure (assisted, perhaps, by an injudicious partial closing of the throttle valve) caused the starting of one or more of the tubes from the forward tube-sheet, and this sudden relief of the pressure caused a foaming in the boiler, by which the water was thrown over the heated tubes, and being thus rapidly evaporated, caused an instantaneous increase of tension, which the additional openings were incompetent to relieve, and thus produced the rupture of the outer shell of the boiler. This, however, is intended only as a plausible suggestion, and by no means as a confident affirmation of the cause of the explosion.

But whatever hypothesis may be adopted to explain this unfortunate accident, its investigation has forcibly called the attention of the committee to several matters which

* r having his attention repeatedly called to rtance of this part of his testimony, he still tly asserted that no steam was escaping valve at the time the engine passed him.

† The boiler of the "Neversink" being of wrought iron, one-fourth of an inch-thick (at minimum), and 41½ inches in diameter, would, according to Oliver Evans' rule, (Young Steam Engineers' Guide, p. 23), sustain a pressure of 51·4 atmos.

The formula is $p = \frac{2st}{d}$:

Where p = the bursting pressure. s = a constant depending upon the tenacity of iron, =, according to Evans, 6400. t = thickness of iron in tenths of an inch. d = diameter, in inches,

$$\frac{12800 \times 2{\cdot}5}{41{\cdot}5} = 771 \text{ lbs.} = 51{\cdot}4 \text{ atmospheres.}$$

they believe to be of sufficient practical importance to deserve the attention of the Institute.

First. The necessity of providing all steam engines with a second safety-valve, of large dimensions, regulated to the maximum pressure which the engine is intended to bear, and placed beyond the control of the engine-man. It is true that this will entail upon the owners the trouble of frequent examination to maintain the efficiency of such a valve, but this trouble will be more than compensated by the increased safety which will be procured by its use.

Secondly. The uncertainty of the ordinary gauge-cocks, as indicators of the water level, under the most favourable circumstances, and the deceptive character of their indications upon the modern locomotive engines, where the amount of work to be done and the restricted space which can be allowed to the boiler, necessarily confines the water and steam room, and renders the evaporation more tumultuous than in the larger boilers of stationary engines.

The incompetency of the gauge-cocks to indicate the true water level, especially under high pressures, is admitted by most writers upon the steam engine (*Pole, on the Cornish Engine*, pp. 61, 108, note; *Alban on the High-pressure Steam Engine*, p. 111,) and is noticed in the report of the Franklin Institute Committee on Explosions (*Journal* vols. xvii., p. 8, *et seq.*, xviii., p. 295), who recommend the glass-tube water gauge, in which recommendation the present committee cordially join, believing that there are no objections to its use which cannot be easily overcome.

Thirdly. The committee would suggest the inquiry whether it is not feasible and advisable so to construct the locomotive engine that explosions, if they occur at all, shall take place in such a manner as to be less destructive to human life than they are at present. One of the great recommendations of the tubular boiler, when first introduced into use, was this very diminished liability to do injury, by allowing a tubular flue, of comparatively small size, to collapse, in place of the large cylinders, by which the boiler was at once emptied of its contents.

The perfect condition of the fire-box of the "Neversink" showed the committee how well the superintendent of the Reading Railroad has guarded against the determining cause of the explosion of the "Richmond," and the committee would earnestly recommend to him, and the ingenious mechanics with whom he has surrounded himself, as well as to our locomotive builders generally, to devote their attention to this matter of contriving some means by which the accidental explosions of these indispens dangerous machines may be rende destructive to those who are in cl them.

By order of the Committ
WM. HAMILTON, A

Philadelphia, March 11, 1847.

THE CENTURION PAPERS.—No

(Continued from page 57.)

[In these times of election- ment, the following question wi some interest. We do not thinl appeared before; but at any rate excellent exercise in algebraic n ment, and the solution very neat M.M.]

3. *Election Manœuvres.*

At a late election for the co ———, there were four candidate C, D of the four several shades litical creed, radical, whig, conse and tory. Party spirit ran hig each candidate professed to stan his own independent interest; an fore tried to obtain as many plum possible. However, secret coalitio formed. A united with B, and s him with 453 split votes from tended plumpers; but B was only repay the favour with 296 votes. evening of the first day's electio ceived overtures from C for a coalition, and supplied him wi votes, and received in return 17 C. The next morning C formed with D, which gave him the be 135 votes, for which he is able to return 163.

Now D has of actual plumpe less than A and B together. It w found that of the independent 2426 voted for A and B; 2604 fo C; and 2301 for C and D. Mo the number of the voters for A together was 15305; for B and gether, 15625; and for C and I ther 14196; whilst from various 183 electors did not exercise thei chise at all.

Which were the successful can —how many plumpers did each late upon at the outset—what w constituency — and which can would have "got in," had there b coalition formed?

Solution.

Let u, x, y, z be the plumpers

tually given to A, B, C, D re-
y; then the coalitions and the independent votes, give for the numbers polled by each candidate as follows:

$$A\text{'s} = u + \quad (296) + \quad (2426) = u + 2722 \ldots (1)$$
$$B\text{'s} = x + (453 + 176) + (2426 + 2604) = x + 5659 \ldots (2)$$
$$C\text{'s} = y + (187 + 135) + (2604 + 2301) = y + 5227 \ldots (3)$$
$$D\text{'s} = z + \quad (163) + \quad (2301) = z + 2464 \ldots (4).$$

But by the conditions of the question, we have

$$z = u + x - 504 \ldots (5)$$

And $u + x + 2722 + 5659 = 15305$, or $u + x = 6824 \ldots (6)$

$$x + y + 5659 + 5227 = 15625, \text{ or } x + y = 4739 \ldots (7)$$
$$y + z + 5227 + 2464 = 14196, \text{ or } y + z = 6505 \ldots (8)$$

From (5, 6) we get

$$z + 504 = u + x = 6824, \text{ or}$$
$$z = 6320, \text{ the plumpers given to D} \ldots (9).$$

From (8, 9) we have

$$y + 6320 = 6505, \text{ or } y = 185 = \text{C's plumpers} \ldots (10).$$

From (7, 10) we have, similarly,

$$x + 185 = 4739, \text{ or } x = 4554 = \text{B's plumpers} \ldots (11)$$

d finally, from (6, 11) we get

$$u + 4554 = 6824, \text{ or } u = 2270 = \text{A's plumpers} \ldots (12).$$

these it follows that the votes
;iven for the several candidates
:ly were as follows:

r A, $2270 + 2722 = 4992$,
. B, $4554 + 5659 = 10213$,
. C, $185 + 5227 = 5412$,
. D, $6320 + 2464 = 8784$.

e, the successful candidates
nd D.

; to find the number of plump-
:h each candidate originally
upon, it is obviously, only ne-
› add to the numbers u, x, y, z
obtained, the numbers which
pectively split by arrangement
ie polling days.

led 453 of his plumpers with B,
ned 2270; whence he had pro-
$2270 + 453 = 2723$ plumpers.

plied 296 splits to A and 187
naking therefore his promised
: to be $4554 + 296 + 187 = 5037$.

ined 185, and split with B and D respectively 176 and 135 votes; whence the promised plumpers to C were $185 + 176 + 135 = 496$.

D retained 6320 plumpers and split 163 with C; and hence the number promised to him was $6320 + 163 = 6483$.

To find the constituency, in the next part of the problem.

Since those who voted for A and B were essentially distinct from those who voted for B and C, and each of these classes again distinct from those who voted for C and D (no elector having more than two votes), it follows that the sum of these three classes, constitutes the class of independent electors; or of those who had not promised plumpers to either of the candidates. That is,

$$2426 + 2604 + 2301 = 7331,$$

the number of independent voters.

These added to the sum of the *promised* plumpers, and to the number who did not vote at all, constitute the entire constituency, whence,

$$7331 + (2723 + 5037 + 496 + 6463) + 183 = 22233$$

ber of electors of the entire

r remains to ascertain whether
ıœuvres affected the independent
the canvass. To find this we
r to subtract from the number
each candidate the votes which
ıed by the splits, in order to
at the final state of the poll would have been, had none of these conditions taken place. This gives:

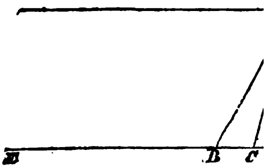
For A, $4992 - 296 \ldots = 4696$,
... B, $10213 - 453 - 176 = 9584$,
... C, $5412 - 187 - 135 = 5190$,
... D, $8784 - 163 \quad = 8621$.

Wherefore the trickery of the scheme did not alter the return of the candidates B and D.

In the 4th volume of "Montucla's Histoire des Mathematiques," the following experiment is recorded—which, as being likely perhaps to interest some of your readers, and being contained in a work so little read or known to practical men, I here transcribe. Thevenard, the author of the experiment, is stated to have been "Capitaine de port à l'Orient." "L'auteur voulut connaitre par experience l'effet des lignes d'eau convexes et celui des mêmes lignes concaves vers la partie anterieure de la proue pour la marche des bâtimens. Dès 1757 il avoit essayé cette comparaison sur deux frégates de 26 canons qu'il contruisit à Grandville, toutes deux sur le même plan, avec des matures, des gréemens et des apparaux semblables; et presidant à ces operations pour obtenir une grande egalité entre elles, il eut soin d'en faire les chargemens de parties semblables pour les deux navires, tant en qualités ou pesanteurs qu'en quantités, et il presida à l'arrimage pour qu'ils fussent egaux en tout point; ils sortirent du port le même jour, entierement armés, il monta sur l'un d'eux pour comparer leurs courses et leurs evolutions, louvoyant dans la vaste baie de Cancalle, pour arriver au mouillage ordinaire de cette côté. Mais avec cette grande egalité qu'il tachoit d'obtenir entre ces bâtimens, il avoit mis une grande difference, peu sensibles aux yeux du vulgaire, qui n'en pouvoit prevoir les consequences: l'une de ces frégates avoit la quille plus courte de 8 pieds que la seconde, c'est à dire, que sur une même longueur absolue de flotaison, la première avoit 12 pieds d'elancement d'etrave, et l'autre 4 pieds seulement; et les marins jugeoient que ce bâtiment auquel ils voyoient ce qu'ils nommoient une pince et une forme apparente aiguë vers l'endroit le plus bas de la proue, auroit l'avantage pour mieux marcher et mieux pincer au vent que son competiteur. Sans être entièrement opposé à cet avis, le citoyen Thevenard avoit des doutes par lesquels il avoit fondé en secret l'essai et la comparaison qu'il vouloit faire pour l'avantage de l'art.

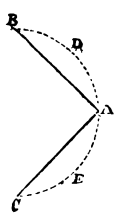
"Le résultat de toutes les observations sur les manœuvres, les mouvements, et les vitesses de ces frégates fut que la première, dont la quille etoit raccourcie de 8 pieds, qui n'avoit pas cette pince, dont la vue avoit été séduite, dont les lignes d'eau vers la partie b l'avant n'étoient point concaves, chait mieux sous toutes les allures, un peu mieux au vent, et viroit d avec un peu plus d'aisance que cell la quille, plus longue de 8 pieds bloit devoir procurer plus de laterales contre la dérive, et mie viser l'eau."

The phrase "elancement d'et corresponds, I believe, to the E "rake of the stem," and is measu the angle which the stem makes w vertical: thus,



if AB and AC be the stems of t frigates, AD a perpendicular to t ED, the frigates being in other r equal, or AD the same for bo "elancement d'etrave" of one w measured by BD = 12 feet, and t the other by CD = 4 feet.

With reference to this and al similar experiments, there is one c stance which ought never to be fo (as it often has), and that is, tl *real surface of resistance* at the a ship is never the *bow itself*, but tain mass of water which is carrie before the ship, and at rest relativ Thus if AB, AC, represent the the real surface of resistance is a shaded mass of water, such as A AEC.



This fact is easily proved—if of wood, or any floating substa dropped from the bowsprit it soon as it gets into this quiescen remain there at a certain distan the ship, and be carried along wi

A great many of the discussions

m of bow are rendered perfectly om neglecting this consideration.

A. H.

— In the paper of mine con- n No. 1248, there is a singular ition of a paragraph from one to another, which the reader will : goodness to correct.—Page 32, the paragraph beginning "As ," &c., line 26, from column 1 lete the sentence at the bottom econd column, thus "P_1dx + &c. dent to such a series as $Q_1 \times S_1$ S_2 + &c."*

—◆—

.KER'S HYDRAULIC ENGINE.

hursday (July 8th) a public trial le with Mr. Walker's Patent ic Engine, being the first one :d for a large estate at British n the West Indies. The engine ı erected in a capacious sunken Mr. Walker's premises in the oad, City-road. The machine of two steam cylinders and two linders or pumps, placed verti- eath them; a crank shaft con- : two steam pistons, and car- -wheel between them. From heads of the steam pistons, two g rods pass down to the plat- on which the water pistons are The latter work in two pump open at the bottom and termi- a valve box at the top leading xit main of the engine. The ı the top of the barrels, as well in the pistons, are of a novel nious construction, in some resembling the grid-iron valve in Mr. Walker's former patent, instead of bars playing upon flat valve is formed of rolled tubes ıalf-round seatings; an arrange- ch affords unexampled facility issage of the water, and at the e ensures certainty of action in with the smallest possible shock he machinery. The steam cy- 'e each 11 inches in diameter; : cylinders 24 inches, with a troke. Contrary to the action of ordinary pumps, in Mr. Walker's engine the water rises in an almost continuous stream by virtue of the momentum imparted to it by the speed of the piston; so that the ordinary rules of calculating the power of pump work is wholly inapplicable to this engine. When working with a steam pressure of 35 lbs. upon the inch, and the crank shaft making 70 revolutions per minute, six thousand gallons of water are delivered in that time, the lift being about 7 feet. By increasing the pressure of the steam, and consequently the speed of the engine, the quantity of water raised increases in a geometrical ratio. For the purpose of the present exhibition only one steam boiler was employed, but when set up in its destined place, two boilers will be employed with so large a measure of flue spaces as to effect the utmost economy of fuel. For the same purpose, Mr. Walker employs a hot-water box of an admirable construction, within which the cold water pumped up is heated by the waste steam to the boiling point, and in that state delivered to the boiler. The steam cylinders are single acting, *i. e.*, steam is admitted on the under side of the pistons only by means of a slide valve placed beneath the cylinders, and worked by an eccentric on the crank shaft. The water cylinders are sunk in a large iron well, fitted with sluices which communicate at pleasure with the water in the drains, or with the external river. The delivery-box is fitted with similar contrivances to send the water raised, out into the river, or back into the canals, so as to be equally applicable for draining, or irrigating.

A number of scientific gentlemen, West India proprietors, and persons interested in draining both at home and abroad, witnessed the performances of Mr. Walker's engine, as did also Earl Grey, Secretary of State for the Colonies; all of whom expressed their entire satisfaction with its performances, and it was admitted to be the most compact, most powerful, and most economical machine ever applied to this important purpose. The machine occupies a space of less than 4 feet square. Machines of less power, and destitute of many of the improvements which contribute to the efficiency of the present one, have been for sometime employed with the best results by the Commissioners for draining in Somersetshire, Norfolk, and in Lincolnshire. In

ransposition" referred to arose from having inadvertently mis-paged his marking page 4 as page 3. The printer ıs some incongruity, but thought him- as all printers do, "to follow copy;" or, whose more special duty it is to see or readableness of what is published nction, was absent from England dur- age of the last number through the M. M.

the county of Norfolk, a large tract of land is at this time growing the finest corn, which has never before been cultivated, owing to the impossibility of properly draining it by the means heretofore employed for that purpose.

The West India proprietors have expressed a deep interest in the success of Mr. Walker's invention, as it will enable them to avert the only serious evils they have now to contend with—alternately floods and drought.

The simplicity of the machine is such, that it can be set up, and at work within a week of its arrival, and may be driven by a labourer or ploughboy.

A second machine is in the course of erection for trial at Mr. Walker's wharf.

REV. T. P. KIRKMAN'S REPLY TO W. S. B. WOOLHOUSE, ESQ.

Sir,—I beg your permission to offer my best thanks to Mr. Woolhouse, for the very kind and courteous manner in which he has done me the honour to reply, in No. 1248, to my remark at p. 604 of your last volume.

I am content that any of your readers should think, as Mr. Woolhouse thinks, that the restriction which my demonstration imposes upon the enunciation of the theorem proposed as the Prize Question for 1845, required no acknowledgment; at the same time, no one will, I trust, incur his displeasure, who may conceive that the sums of quantities compared in that enunciation are to be considered arithmetical, without reservation for algebraical changes of signs; and that a line of distinct notice was fairly due to those correspondents who supplied the requisite correction of the theorem.

Upon reconsideration of the remark that I have diffidently offered, p. 608, upon the Prize Question for 1846, I find, and I here acknowledge that my *reductio ad absurdum* is itself absurd, and that the answer which I ventured to substitute is, as Mr. Woolhouse affirms, undoubtedly incorrect. The confusion of my ideas arose not, as Mr. Woolhouse naturally conceives, from my neglecting to observe the vertical force F sin θ, but from my observing it but too well. Seeing that, at each of the points of contact between the spheres, there is an equal and opposite force exerted, $-$F sin θ, (equation (1) and (2)); then applying the rule of addition, and attempting too far to simplify my conceptions, I dismissed all regard to the vertical effect of friction, and demanded an account of the downward pressure 4W. I thus landed again and again in the difficulty that I have stated—I hope with sufficient modesty. Many, vastly my superiors in science, will perhaps sympathise with an embarrassment arising from my unwillingness to trust everything to the magic symbols of a general method, even when I saw that the resulting equations were unassailable by direct reasoning.

I hope that the gentlemen whose names are appended to the solution in question, will readily find, in the deferential form, employed by me, all the apology which would otherwise have been so justly their due. T. P. K.

Croft Rectory, Warrington.
July 14, 1847.

THREE-CYLINDER ENGINES.

Dear Sir,—In the last part of your Magazine (p. 556) are some observations by "J. H." on the late accident on the South Coast Railway; and, in order to avoid the oscillations of the engine, which he considers to have been the cause of the accident, he proposes to have a third cylinder added, and seems to say that the idea is quite original, as the engine which had run off the rails was one of "Stephenson's LAST patent."

Your correspondent seems not to be aware that Mr. Stephenson has constructed an engine some time ago, embodying the improvement he names, namely, having two cylinders placed on the outside, and a third one, "of the united area of the outer ones, placed between," for the express purpose of hindering such oscillations of the engine. I am not aware whether a patent has been procured for it; but the "new idea" must be due to Mr. Stephenson, and not to "J. H.:" and the engine which caused the late accident is not the *latest*.

I am, Sir, yours, &c.,
A SUBSCRIBER.

DECIMAL NOTATION.

Sir,—In reply to "W. R.," respecting the method of writing money amounts, published in No. 1246, I beg to say, that the horizontal line placed above a figure is instead of the unit which is prefixed to it in the ordinary method. I thought this would have been apparent from the example, without occupying your columns with an explanation—as it was stated the object was to save space, and not to facilitate computation.

I do not believe the new way would be attended by more errors than the old. A

person who would omit the horizontal line, would omit the unit; and it must be placed very carelessly, to appear doubtful which of two figures it belongs to: this error is also very improbable from there being but two amounts of pence, viz. 10d. and 11d., with which it could be made.

I am, Sir, yours, &c., W. O.

Islington.

BARON VON RATHEN'S COMPRESSED AIR LOCOMOTIVE.

In our journal of the 12th of June, we made mention of some experiments which we had the pleasure of witnessing at the College for Civil Engineers, Putney; which had for their object, to test the practicability of Baron Von Rathen's new plan (patented, but still unspecified) of working locomotive engines by compressed air. We stated, that we had seen on that occasion air compressed to upwards of 850 lbs. per square inch, and this enormous power set free again with the greatest facility for locomotive purposes—that is to say, not all applied at once, but "set free," or let off, as wanted, in quantities proportionate to the work performed. We noticed further, that there was a common-road locomotive in the course of building at the workshops of the college, which was intended to be worked on this plan. Since then some additional experiments have been exhibited by Baron Von Rathen; for the following particulars of which we are indebted to an eye-witness:

On the 8th instant the compressed air reservoir was again charged to upwards of 800 lbs. per square inch, in the presence of a number of gentlemen who have associated to make trial of the Baron's system, and if that trial prove successful (of which there seems now every probability), to promote its general adoption on railways and common roads; and, in order to show the perfect control under which this prodigious force is kept, and the ease with which it may be applied, in more or less abundance, the air was allowed to escape from the reservoir, at intervals regulated solely by the pleasure of the persons superintending the experiment. The noise made by these successive escapes of air was like that of a battery of cannon. Another point which remained to be practically demonstrated was, the length of time which the reservoir was capable of retaining a body of air under so high a state of compression; and in that respect also the result was in the highest degree satisfactory. Four days after the experiment just described, the reservoir was again tried, in the presence of the Duke of Buccleugh (the enlightened and public-spirited patron of the college) and several other noblemen and gentlemen—being still in the same state in which it was left on the 8th instant, and reduced only in its original force by the amount of air discharged from it on that occasion. The working power of the apparatus was now found to be, for all practical purposes, in as high a state of perfection as ever, the air issuing with apparently undiminished elasticity from its state of confinement, and with a noise which could only be likened, as before, to that of heavy artillery. Of no other motive power yet invented can it be said that it is capable, like this, of being stored up in any quantities, not only till the occasion arrives for its use, but in a state always fit for instant use; stored up, moreover, in vessels which may be either stationary or carried about from place to place. Of no other known power, either, can it be said, with so much truth, that it is unlimited in its source, and free from everything like nuisance in its application.

CALENDAR OF SPECIFICATIONS OF PATENTS OF INVENTIONS. FROM THE PERIOD WHEN THE PRACTICE OF ENROLMENT COMMENCED TO THE PRESENT TIME.—CONTINUED FROM P. 599, VOL. XLVI.

[From the Reports of the Deputy-Keeper of the Public Records (Sir Francis Palgrave).]

THE CALENDAR.

[Of the two dates annexed to each entry, the first is the date of the patent, and the second that of the enrolment of the specification.]

John Davis, of Long Acre, coachmaker: of a new method of hanging coaches, vis-à-vis, and other bodies, so that, in case the carriage should be overturned, the body will remain upright and free from the ground. Cl. R., 27 Geo. 3, p. 7, No. 6. Aug. 11, 27 Geo. 3; Sept. 7, 27 Geo. 3, 1787.

Thomas Mitchell, writer, of Perth: of a new method of raising water and other fluids, for the purpose of driving mills and other machines, and watering lands. Also for draining lands, and pumping or clearing water from ships, and for extinguishing fires in houses, and other useful purposes. Cl. R., 27 Geo. 3, p. 7, No. 3. Aug. 28 last; Sept. 26, 27 Geo. 3, 1787.

Samuel Hooper, of the parish of St. Giles-in-the-Fields, bookseller and stationer: of a new method of making or manufacturing printing paper, particularly for copper-plate printing. Cl. R., 27 Geo. 3, p. 7, No. 1. Sept. 17, 27 Geo. 3; Oct. 17, 1787.

John Shankster, of Great Pulteney-street, Westminster, oval turner: of a new method of hanging of coaches, chariots, phaetons, calashes, gigs, chaises, and other carriages, whereby the lives and limbs of her majesty's subjects, to be conveyed therein and thereby, are rendered more safe and secure than in or by any other carriage heretofore made, built, and hung, for the carriage or conveyance of

persons travelling and otherwise conveyed thereby. Cl. R., 27 Geo. 3, p. 8, No. 3. Oct. 6 last; Nov. 6, 28 Geo. 3, 1787.

John Collinge, of Bridge Road, Lambeth, cabinet-maker: of an improvement in making of carriage and other wheel boxes and axletrees, which will be more durable and less liable to be out of order than any now in use. Cl. R., 27 Geo. 3, p. 8, No. 1. Nov. 2, 1787; Dec. 1, 28 Geo. 3, 1787.

Thomas Mead, of Sandwich, carpenter: of an invention of a regulator on a new principle for wind and other mills, for the better and more regular furling and unfurling the sails on windmills without the constant attendance of a man, and for grinding corn and other grain, and dressing of flour and meal superior in quality to the present practice, and for regulating all kind of machinery where the first power is unequal. Cl. R., 27 Geo. 3, p. 14, No. 1. Nov. 15, 28 Geo. 3; Dec. 14, 1787.

Thomas Henderson, of York, stucco plaisterer: of an instrument (discovered by the specifier's father, and by him imparted) by which every visible object may be drawn and taken to any size, on true mathematical principles, with great accuracy and facility. Cl. R., 27 Geo. 3, p. 15, No. 19. Dec. 19, 27 Geo. 3; Jan. 6, 1787, 27 Geo. 3.

John Garnett, of Redland, Gloucester, merchant: of a method of greatly reducing the friction of an axis or fulcrum, useful for all axles, wheels, beams, levers, pendulums, blocks, pulleys, and other instruments that have a partial, total, or repeated revolution or oscillation. Cl. R., 27 Geo. 3, p. 15, No. 3. Jan. 6 last; Feb. 26, 27 Geo. 3, 1787.

Richard Heaton, of Chevat, near Wakefield, farmer: of a drill harrow which sows and harrows at the same time, and which is on an entire new construction; for the sowing of all kinds of grain, turnip, rape seed, &c., and any quantity of any kind of seeds with the greatest regularity upon an acre, and the rows at any distance from 6 to 36 inches; it soweth without bruising the seed, or any difference in the quantity of seed either up hill or down; and as the quality of land frequently differs in the same close, the person that holds the machine may vary it at pleasure to suit the land as he crosses or goes up or down the close without standing to alter it; it soweth ridged lands of any size with the same propriety and expedition as level, it also makes drills in any kind of lay or strong land; it soweth brin'd and hin'd wheat and long oats with as great propriety as other corn; it soweth hand tillage (that is rape-dust, pigeon-dung, &c. if required) either in the drill with the corn, or on each side, or both; it marks the place where the horse is to go, so that the rows stand regularly, and the work ma formed with one horse. Cl. R., 2 p. 16, No. 1. March 10, 27 Geo. 3 31, 27 Geo. 3, 1787.

Insulation of Telegraphic Signal Posts Cornell, of Ithica, N. Y., is the inventor tiful and efficient contrivance for insulatir on telegraphic posts. By this inventio can never be carried to the earth in wet is frequently the case to the great annoy operation. The contrivance consists in the lower part of the glass knob a bell- this resting on the wooden pin, so that side will always be perfectly dry. Anoth the same inventor, to effect this object an *iron* knob similarly shaped, but lined der side with glass, and a glass bush t wire through; this latter knob cannot be broken by stones being thrown at it. has been introduced with perfect succe Buffalo line, where communications of fi miles are as certainly and easily carried the street. *Eureka.*

LIST OF ENGLISH PATENTS GRA JULY 17, TO JULY 23, 184

William Hensman, of Woburn, Bedfo certain improvements in thrashing machi 17; six months.

Pierre Armand Lecomte de Fontaine 4, South-street, Finsbury, for certain imp in machinery for preparing cotton and o substances. July 17; six months.

Henry Bessemer, of Baxter House, St. Pancras-road, Middlesex, engineer, fc ments in the manufacture of plates, shee of glass. July 17; six months.

William S. Henson, of London, for c provements in the construction of razo ing. July 17; six months.

Robert William Sievier, of Henri Cavendish-square, Middlesex, gentlema tain improvements in stamping, markin embossing, or printing. July 17; six m

John Sykes and Adam Ogden, both of field, York, for improvements in mac cleaning wool, cotton, and similar fibrous from burs, motes, and other extraneo July 17; six months.

James Whitley, of Botany, Bingley, for certain improvements in the mode o scouring, and dying of wool, alpaca, moh and other fibrous substances. July 19; si

Edward Light, of Esther-terrace, Be master mariner, for improvements in for supporting or buoying up persons, other bodies when in the water. Ju months.

Joseph Tall, of Bineton, Surrey, b improvements in apparatus for setting s 19; six months.

Edward Slaughter, of Avon-side Iro Bristol, engineer, for improvements in engines. July 19; six months.

Anthony Bernhard Von Rathen, of Pu rey, civil engineer, for certain universal improved direct rotatory engines, to be steam, air, or any other elastic power. six months.

Joseph Jean Baranowski, of 3, Rue Ne Paris, gentleman, for a ready-reckonin July 19; six months.

John Lewthwaite, of Halifax, York, for certain improvements in numbering July 23; six months.

Harry Joseph Perlback, of Hamburgh, an improved method or methods of unit metals and alloys of metals. July 23; si

Henry Samuel Rayner, of Ripley, I engineer, for certain improvements in on land and water. July 23; six month

LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED UNDER 6 AND 7 VIC. CAP. 65.

Date of Registration.	No. in the Register.	Proprietors' Names.	Address.	Subject of Design.
July 15	1134	William George Bentley	High Holborn	Anti-evaporation blacking apparatus.
17	1135	A. & M. Burton	Holland-street, Blackfriars	Effluvium flap, or valve, for drains.
„	1136	Welch, Margetson, and Co.	Cheapside, London	Elastic mourning band.
„	1137	James Thornton	Waterford, architect	Improved jaunting car.
„	1138	Samuel Messenger	Birmingham	Railway carriage roof lamp.
„	1139	Barrett, Exall, and Andrews	Reading, Berkshire	Feed gear to chaff cutters.
19	1140	William Hyatt	Plummer-street, City-road	Apparatus for regulating the supply of water to the condensers of steam engines.
„	1141	James Milne & Son	Edinburgh, brass-founders, &c.	Improvement in gas-meters.
20	1142	James Davis	King-street, Frome, Somersetshire	Balanced valve gulley trap, to prevent the ascent of noxious vapours from sewers and drains.
„	1143	Keith Imray, M.D.	Devonshire-street, Portland-place, London	Pessary for the relief of prolapsus uteri, or prolapsus ani.
21	1144	John William Phelps	Cheapside	Spiral abdominal supporter for prolapsus uteri.

Advertisements.

CONTENTS OF THIS NUMBER.

LONDON: Edited, Printed, and Published, by Joseph Clinton Robertson, of No. 166, Fleet-street, in the City of London.—Sold by A. and W. Galignani, Rue Vivienne, Paris; Machin and Co., Dublin; W. C. Campbell and Co., Hamburgh.

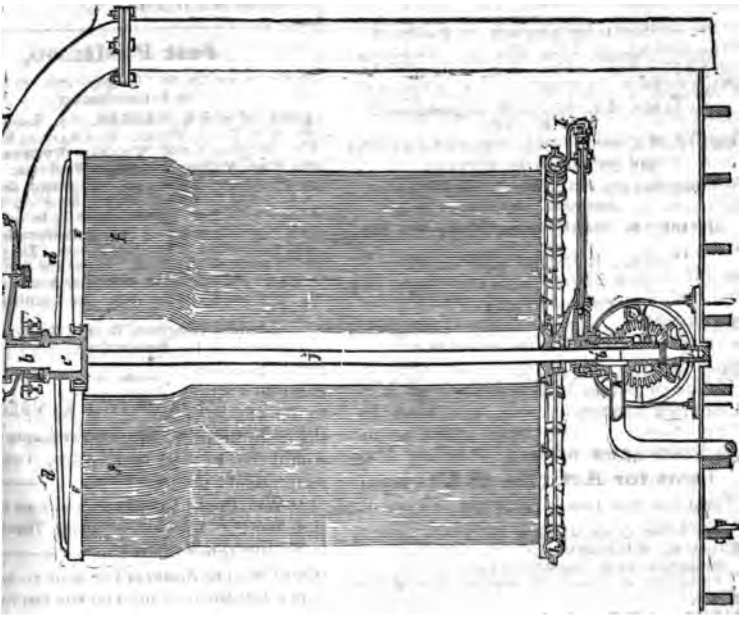
Mechanics' Magazine,

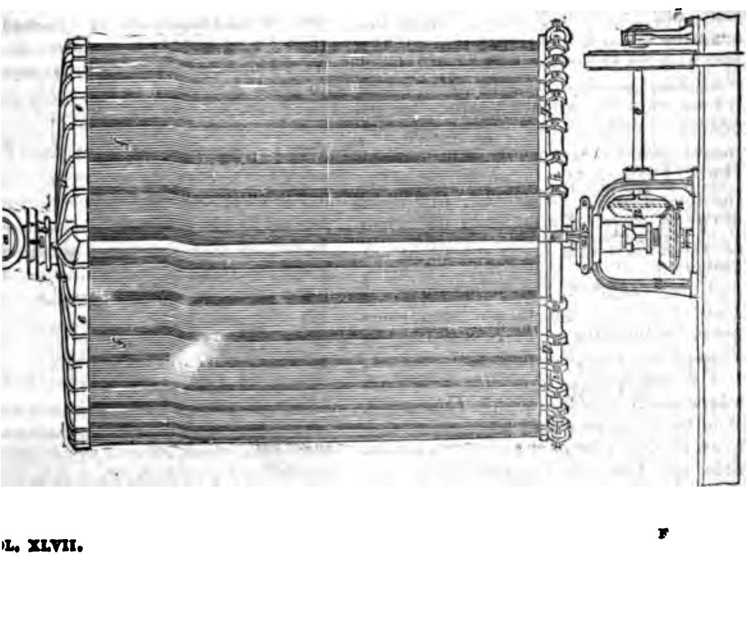
SEUM, REGISTER, JOURNAL, AND GAZETTE.

1251.] SATURDAY, JULY 31. [Price 3*d*.

Edited by J. C. Robertson, 166 Fleet-street.

CRADDOCK'S STEAM-ENGINE CONDENSER.





CRADDOCK'S STEAM-ENGINE CONDENSER.

[Patent dated December 3rd, 1846. Specification enrolled June 3rd, 1847.]

The name of Mr. Craddock, as an improver of the steam-engine, is not unknown to our readers. In 1840 he took out a patent for improvements in "steam engines and steam boilers," the nature of which was fully described in several communications, from Mr. Craddock himself, inserted in this journal, vol. xxxvi, p. 246, and vol. xxxviii, pp. 177, 245, 516. Since then, Mr. Craddock appears to have been assiduously engaged in improving and perfecting his original plans; and this has led to a second patent, the specification of which—a very long, and somewhat multifarious document—is now before us.

It may be in the recollection of our readers, that the most prominent portion of Mr. Craddock's inventions, was a new method of condensation, by the external application of cold air; and in the present specification this also holds a foremost place. We propose this week to confine ourselves to this branch of Mr. Craddock's improvements, and shall, in future numbers, bring the others under the notice of our readers.

The merits of Mr. Craddock's system of condensation have been the subject of a good deal of discussion,—more distinguished, we regret to say, for carping illiberality and disingenuous misrepresentation, than for truth and candour. He has been represented as putting forward his air method as superior to the ordinary method of condensation by water; whereas he has again and again stated most emphatically, that he only offers his method for adoption where water cannot be had, or only at great cost and inconvenience. We quote an instance or two: "I cannot say it is so simple as the injection (water) condenser; *this must stand in point of simplicity without a rival;* but simplicity may be too dearly bought when it entails practical evils, and stops short of the fullest development of the utility of the steam-engine:" *Chemistry of the Steam-Engine Practically Considered*, p. 63.* Again, "*I do not propose to condense with air where water is obtainable,*" *Ibid.* p. 72. And to the same effect, when adverting to an implied charge of seeking to supersede the Cornish engines which are used "where water is plentiful," serves, "*Let it be clearly und that I propose no such thing,*' p. 73.

Keeping in mind, therefore, w real scope is of Mr. Craddoc provements in condensation, let what the advantages are which w gained by its adoption. If all the required for the working of an can be condensed by the externa cation of air, as fast as it is use the same quantity of water, suffices for the first supply of the may be worked over and over with but small diminution; and may be employed to nearly a advantage where water is scan dear, as where it is abundant and Take, for example, the case of a —where the engine has to carry a along with it to supply it with wa must, as often as that tender is e come to a stop in its swift career, to be replenished—the gain her the adoption of Mr. Craddock' would be one of the utmost consequence:

"We should in this way dispe the tender altogether; nor sh want any more than a very smal tity of water, if any, over and ab contained in the boilers, *for the journey England presents.* I m tion, as an illustration in proof *that I once worked an engine f weeks, without the addition of an to that contained in the boiler commencement of the experimen* boiler was one of the common cyl kind: it was three parts full in instance, and at the termination experiment was half full; the lost being equal to four gallons It will at once be seen that no water can take place, but tha leaks through the joints; therefor we keep our joints perfectly ti same water may circulate thro engine for years."—*Chemistry Steam Engine*, p. 78.

Mr. Craddock enters into a calculation of the saving of powe would be thus effected, and ar the following remarkable results

"With the evaporation of 120 c of water in the present locomoti

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* Simpkin and Co., 92 pp., 8vo.

Fig. 4.

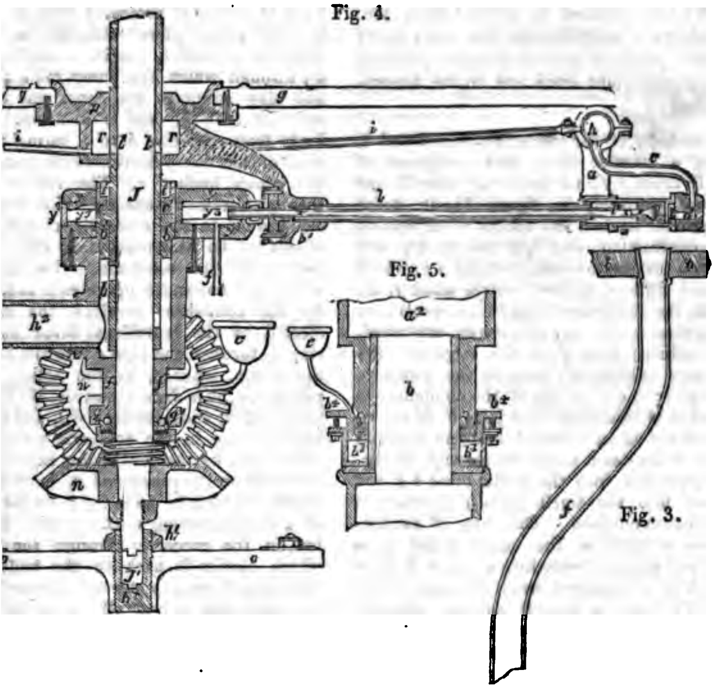


Fig. 5.

Fig. 3.

ower gross is obtainable. We know jet or blast requires power equal to s, and that the resistance induced engine and tender is equal to 23- ower. I have said that my system ispense with the jet, and also with ler; and I may add that, if desir- e engine itself need not be by 4 tons y as those now used for the same We next find that the resistance by the engine and its appendages be reduced from 43 to 11-horse Is it asked how this is to be ? I have anticipated the answer in id shall only observe here, that we of the resistance of the blast by not ig the wasteful expenditure of steam, as led to its adoption. We shall be dispense with the tender, by requir- additional supply of water over and hat contained in the boiler; and, I elieve, we should not require above irter the quantity of coke for the ion of the same power. The neces- the present system, for such an im- olume of steam per minute, requires eight in the boiler; but, on the re- of that necessity, will follow the l weight of the engine. we render 32-horse power available purpose of propelling the train, which now is consumed by the jet, and the extra resistance from the tender, &c., noting the increased power produced from a given weight of steam, with the atmosphere re- moved, or a vacuum of only 10 lbs., we find that such a vacuum of 10 lbs. would, of itself, give us 35-horse power—to which add the 32-horse power we have seen is rendered available by the other diminished resistance. We have then reduced the quantity of water requisite to be evaporated, from 120 cubic feet to 54 cubic feet per hour. But hitherto we have taken no account of the economy consequent on ex- pansion, which would certainly, with steam generated at 115 lbs. per square inch, fur- ther reduce the quantity of water required to 40 cubic feet. Pambour has shown, that only $\frac{75}{100}$ths of the water that passes through the locomotive engine is really converted into steam; so that the quantity of steam to be condensed, to propel a train, such as we have been describing, would not exceed that which can be produced from 33 cubic feet of water. A condenser which would effect the condensation of this quantity of steam per hour, would not be above 30 cwt., and would occupy a circular space of about 5 feet diameter by 7 feet high, or would not stand above the framing of the engine more than 5 feet."

We now proceed to extract from Mr. Craddock's specification his description of the improved arrangements by which these important ends are to be accomplished:

The body of the condenser, figs. 1 and 2, is of a circular form, and composed of small tubes *f f*, all uniformly curved (as shown separately in figure 3), in order to provide against the effects of expansion and contraction, and inserted at top and bottom into hollow arms *e e* and *g g*, which radiate from a hollow central shaft *j*, on which the condenser is made to revolve, or otherwise move, as afterwards explained. The exhaust-pipe a^2, of the large or low-pressure cylinder a^1, conveys the steam to a receiver *c*, on the top of the condenser to which it is connected by a joint *b*, as shown separately on an enlarged scale on figure 5. From *c* the steam passes off through diverging pipes *d d*, into the radial arms *e e*, and thence into the small pipes *f f*, where it becomes condensed. The water of condensation collects in the under radial arms *g g*, and passes thence into a ring *h h*, from which it is conveyed away by pipes *i i* (see fig. 4), into a central annular chamber *v v*, from which there are openings at *t t* into the central hollow shaft *j*. From *j* the water passes into another annular chamber *b*, from which it is conveyed back by the pipe k^2, to the air-pump; *n* Figure 2 is a mitre wheel keyed to the bottom of the central shaft *j*; n^1, another mitre wheel which works into *n*, and is supported by a bracket *m*, having at the outer end of its shaft *o* a pulley n^2, which is connected by a band and pulley *p*, with the axis of the fly wheel. When the rotary motion given to the condenser by means of these wheels and pulleys is not considerable, the air-pump (which communicates with the condensers through the medium of the parts k^2 *b r j* and *i i*) effects as perfect an exhaustion of the condenser as need be, but when the motion becomes rapid, centrifugal force is generated, which has a tendency to retain the water in the circular ring *h*; and to provide against this the following contrivance is adopted:—*y* is a fixed eccentric, in which the central shaft *j* revolves, and *z* is a small horizontal pump pendent by a link *a* from the ring *h*; the eccentric *y* and pump *z* are connected together by a hollow rod *x*, which is at one end attached to the pump bucket *e*, and at the other to the eccentric clip y^2, terminating in a hollow space y^3, in the body of that eccentric; *l* is an outer tube which encloses the hollow pump-rod *x* and communicates by an aperture at l^2 with the hollow rod *x*; *u* is a bracket projected from, a[...] in the same piece with the a[...] chamber *r*, which carries a stuffi[...] b^1, through which the pump-rod *x* [...] and also supports the inner end [...] external tube *l*; and *c* is a pipe [...] leads from the ring *h* to a valve *d* [...] head of the pump barrel, which ope[...] the pump bucket *e*. The rod *x* [...] through a jointed cross-head x^2, befor[...] screwed on to the eccentric clip y^2 [...] allows of its accommodating itself [...] motion of the eccentric. The m[...] which the apparatus operates is as f[...] As the condenser revolves the w[...] ejected by the centrifugal force fr[...] ring *h*, through the pipe *c* into the b[...] the pump, whence, by the action [...] pump-rod, it is drawn inwards, till b[...] inner rod *x*, and external rod *l*, and [...] hollow space in the eccentric *y* are [...] and when, by the continuing action [...] eccentric on the pump-rod *x*, more [...] drawn in, room is made for it by the [...] of a corresponding quantity from t[...] low in the eccentric through the [...] which carries it back to the boile[...] unceasing flow of water being thus [...] from the ring *g*, and all ingress of [...] cluded, the retaining tendency of the [...] fugal motion is thus completely neut[...]

The manner in which the tubes [...] condenser are secured at their ends i[...] radial arms *e e* and *g g* is peculia[...] holes are made in the arms at casti[...] afterwards drilled out and tinne[...] tubes are also formed at each end, [...] secured in the manner shown at [...] figure 3, that is, with a bulge on th[...] and a turn over or burr on the [...] When each arm has had all its tub[...] let in, it is dipped into a vessel of [...] tin, by which every joint is made p[...] air-tight and durable. Any strain [...] might arise from contraction or ex[...] is prevented by the curved form g[...] the pipes.

Some other minor details co[...] with the condenser and anti-cen[...] pump, will be found given in the dr[...] figures 3, 4, and 5, and may h[...] briefly described. And first, as reg[...] riveting joint *b*, which connects the [...] pipe *a* with the receiver *c* at the top [...] condenser, the following particulars [...] servable. To its bottom flange t[...] screwed a circular crutch b^3, withi[...] there is a second crutch b^4, upon th[...] step of which the brasses *v v*, wa[...] vulganized caoutchouc) *w*, and coile[...] *x* rest.

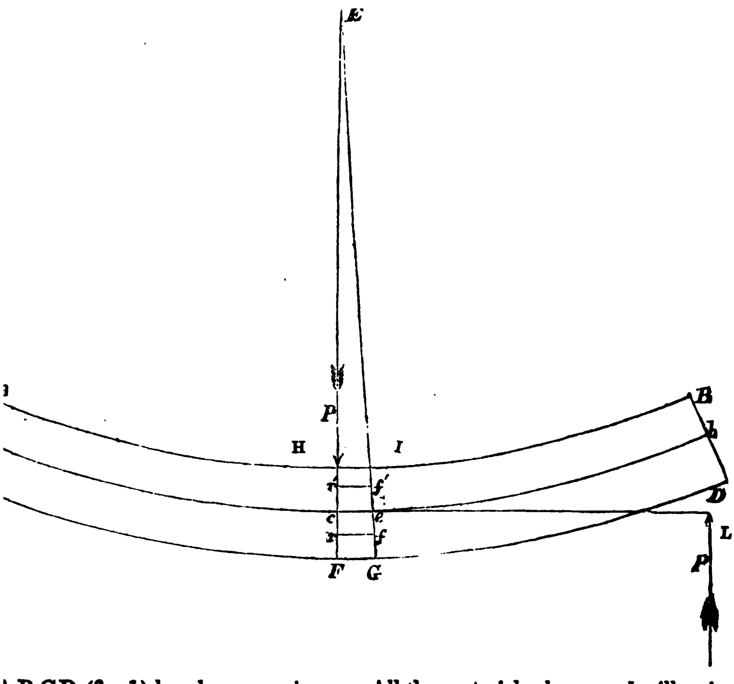
The two outer steps of the crut[...] connected together by binding scr[...]

proportion as these screws are tight- the under step of the crutch b^4 is l up against the spring x. The parts are lubricated from an oil cup ipe of which is carried through the the turned-down end of the exhaust and which, of course, is stationary. radial arms g g (fig. 4), at the of the condenser, are screwed into a iece p and o, fixed to the central , out of which piece the annular r r, before mentioned, is cut. The ic y is bolted to the solid piece f, s bored out to receive the central : c^1, c^1 is a ring which revolves within the eccentric, and moves on the top surface of a solid brass busk b^1, which is also bored out to receive the shaft j. A washer of vulcanized caoutchouc is let into a recess e^1 in the ring c^1. The brasses g^1 have a vulcanized caoutchouc-washer interposed between them, and are kept up to their places by a coiled spring s^2. J^1 is the step and false toe of the bottom of the shaft, and h^1 is a nut that screws on to the brass h^2, and by which the entire shaft can be raised or lowered as much as may be required: o o is the foundation-plate.

(*To be continued.*)

RIDGES.—INVESTIGATION OF THE STRENGTH OF CAST-IRON BEAMS OR GIRDERS LOYED IN THE CONSTRUCTION OF BRIDGES. BY WILLIAM DREDGE, ESQ., C. E.

Fig. 1.



A B C D (fig. 1) be a beam or girting on abutments at C and D; pose it to be acted on by the single e P, applied in a line perpendi-) its original position, which, by of its action, produces a deflec- shown in fig. 1.

r the line E F, in a line with the e P, and intersecting the neutral : b in the point c.

All the materials above $a\ c\ b$ will resist the action of the weights by compression; and all the fibres below will be excited tensionally, wherefore the line $a\ c\ b$, which is situated between these forces, will be neither extended nor compressed; and hence it will be round the point c in this line that the broken ends would turn if the beam were fractured by the force P.

From the point c set off a very small space, $c\,e$, to represent the length of a fibre, as measured on the neutral axis, and from e perpendicular to the curve $a\,c\,e\,b$ draw the line Ge IE, meeting the line FcHE in E.

Now, since $c\,e$ represents the length of a fibre in its natural state, and G E is drawn perpendicular to the curve, it follows, from the above supposition, that F G will be the length of a similar and parallel fibre when extended, and F G $-$ $c\,e$ = the amount of extension of it. For this reason also, H I will be the length of a compressed fibre on the upper edge of the beam, and $c\,e$ $-$ H I = the extreme reduction in length by compression.

Let M = the modulus of elasticity, d = the depth of beam, $d_1 = \mathrm{H}c$, $d_2 = c\,\mathrm{I}$, and the angle $e\,\mathrm{E}\,c = \phi$. Also let the radius $e\,\mathrm{E} = \mathrm{R}$, and any variable distance $c\,r$ or $c\,r' = x$; then

$r'f' - ce = (\mathrm{R}+x)\tan\phi - \mathrm{R}\tan\phi = x\tan\phi$ = the extension of $r\cdot f\cdot$ at the distance x from the neutral axis.

Since the extension of similar bodies is always considered proportional to the pressure, and inversely as the section of the bodies, we shall have—since M represents the force necessary to elongate a bar of iron to twice its natural length, considering it to retain an uniform section of one unit throughout the extension—

$$\therefore \mathrm{R}\tan\phi : x\tan\phi :: \mathrm{M} : \frac{\mathrm{M}x}{\mathrm{R}} =$$

the force necessary to produce the elongation of $x\tan\phi$ in the fibre rf, and consequently

$$\therefore x : d_1 :: \frac{\mathrm{M}x}{\mathrm{R}} : \frac{\mathrm{M}d_1}{\mathrm{R}} = \mathrm{T} \;\ldots\ldots\; (1)$$

Which represents the amount of tension on the lower fibre FG.

Therefore, if T equal the tens the lower surface of the beam,

$$\frac{\mathrm{M}x}{\mathrm{R}} = \frac{\mathrm{T}x}{d_1} =$$

the tension on the fibre $r.f.$ at d tance x from the point c.

Similarly, if C = the compressi the upper surface

$$\frac{\mathrm{C}x}{d_2} =$$

the compression on the fibre $r'f'$ distance x above c.

But, in the event of rupture, th tured ends would turn round the p therefore, on the principle of the lity of moments, it is to this poi the effects of all the forces, which the beam, must be referred.

From c draw the line cL perpe lar to the resolved force of P abutment D. Let P_1 = this re force, and write p for cL.

The effects of the force $\frac{\mathrm{T}x}{d_1}$ round c at the perpendicular distan $\frac{\mathrm{T}x}{d_1}.x$, and the effect of $\frac{\mathrm{C}x}{d_2}$ is =

Now the sum of the effects of the of the forces between cF and cE be equal to the moment of the re pressure P_1. Hence, putting breadth of the beam,

$$\mathrm{P}_1 p = b\left(\int_0^{d_1}\frac{\mathrm{T}x^2}{d_1} + \int_0^{d_2}\frac{\mathrm{C}x^2}{d_2}\right)$$

But the sum of the tensile forc equal to the sum of the compr forces—or $\mathrm{C}d_2 = \mathrm{T}d_1$; whence C = Substituting this value for C

$$\mathrm{P}_1 p = b\left\{\frac{\mathrm{T}}{d_1}\int_0^{d_1} x^2 + \frac{\mathrm{T}d_1}{d_2^2}\int_0^{d_2} x^2 + \right\} = \frac{\mathrm{T}b}{d_1}\left\{\frac{d_1^3}{3} + \frac{d_1^2 d_2^3}{3d_2^2}\right\}$$

$$= \frac{\mathrm{T}}{3}bd_1 d \;\ldots\ldots\ldots\ldots\ldots\ldots\; (2).$$

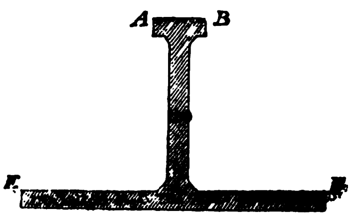
It has been found by experiment that the compressive strength of cast iron is greater than its tensile power. Let it be n times greater then $\mathrm{C} = \mathrm{T}n = \frac{\mathrm{T}d_1}{d_2} \therefore d_2 = \frac{d_1}{n}$ and since $(d_1 + d_2) = d$, we have $d +$ $\frac{d_1}{n} = d$, or $d_1 = \frac{dn}{1+n}$. Whence

$$\mathrm{P}_1 p = \frac{\mathrm{T}bd^2 n}{3(1+n)} \;\ldots\ldots\ldots\ldots\; (3)$$

Since the metal is most extend the under surface, and compressed upper edge, it follows, that to have a

rect section of a girder it should be made flanged; and if the metal be n times stronger on compression than on tension, the lower flange EF (fig. 2) should be n times broader than the upper flange AB, so that each may be equally strong. Fig. 2 is a section of a beam of the form which represents the assumed proportion of the upper to the lower flange as $1 : n$.

Fig. 2.



Put d_3 = the depth of the rib between the flanges, b_1 = AB, and nb_1 = EF. Then, because the metal is equally proportioned on each side of the neutral axis, we have $d_1 = d_2 = \frac{1}{2}d$. Whence,*

$$P_1 p = b_1 \left\{ \int_{\frac{1}{2}d_3}^{\frac{1}{2}d} \frac{Tn}{d_1} x^2 + \int_{\frac{1}{2}d_3}^{\frac{1}{2}d} \frac{Cx^2}{d_2} \right\} = b_1 \left\{ \frac{2Tn}{d} \int_{\frac{1}{2}d_3}^{\frac{1}{2}d} x^2 + \frac{2C}{d} \int_{\frac{1}{2}d_3}^{\frac{1}{2}d} x^2 \right\}$$

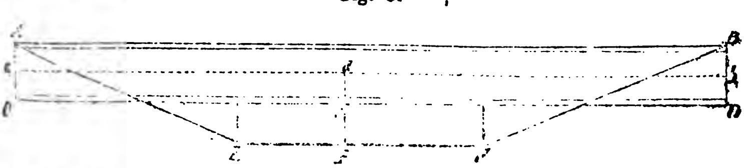
Since, by supposition, the flanges are made proportional to the strain, and the neutral axis passes up the centre of the beam C = Tn, whence

$$P_1 p = \frac{4b_1 Tn}{d} \int_{\frac{1}{2}d_3}^{\frac{1}{2}d} x^2 = \frac{b_1 Tn}{6d}(d^3 - d_3^3) \ldots\ldots (4)$$

is the equation exhibiting the condition of rupture.

Now, since the lower flange resists the effect of the strain by tension; and because malleable iron possesses three times the tensile power of cast iron: it follows that wrought iron would be a much better material than cast iron for the lower flange; and if tension-rods were judiciously applied, so as to relieve the strain from that portion of the beam, they would effect considerable saving in the metal of the lower flange.

Fig. 3.



Let ABCD (fig. 3) be a girder resting on D and C, and having the tension-rods attached at A and B. Put $cf = d_4$ and, in order that the position of the neutral line abc may not be altered, let the lower flange be reduced in size, so as to be exactly equal to the strength afforded by the tension-rods EF. Then if s = the section of the bar EF, and T_1 = the tension, it will resist per square unit; then $T_1 s$ = the strength of the bar EF, and $\frac{T_1 s}{2}(2d_4 + d)$ = its moment round the point c. It has been stated above that malleable iron is several times stronger than cast iron, let it be m times stronger; then $T_1 = mT$, when the moment of the tensile bar round c will be

$$\frac{Tms}{2}(2d_4 + d) \ldots\ldots\ldots\ldots\ldots\ldots\ldots (5),$$

* In this investigation I have not taken into consideration the strength of the rib between the flanges, which is considerable, and therefore any calculation founded on this investigation would be within the limits of the strength of the beam. In the experiments made by Mr. Hodginson, at Manchester, the strongest section of beam, the flanges were in the proportion of 1.:6.1.

which is the effective increase of the power of the lower flange. Put y=the breadth, which may be taken away f the lower flange, then

$$y\frac{b_1 T}{12\,d}(d^3-d_3^3)=\frac{Tms}{2}(e_2 d_4+d)$$

$$\therefore y=\frac{6dms(2d_4+d)}{b_1(d^3-d_3^3)}\ldots\ldots\ldots\ldots(6).$$

Whence the corrected width of the flange will be

$$b_1 n-\frac{6dms(2d_4+d)}{b_1(d^3-d_3^3)}\ldots\ldots\ldots\ldots\ldots(7),$$

Substituting this for $b_1 n$ equation (4) and reducing

$$P_1 p=\frac{T\left(b_1 n-\frac{6dms(2d_4+d)}{b_1(d^3-d_3^3)}\right)}{bd}\left\{d^3-d_3^3\right\}+\frac{Tms}{2}(2d_4+d)$$

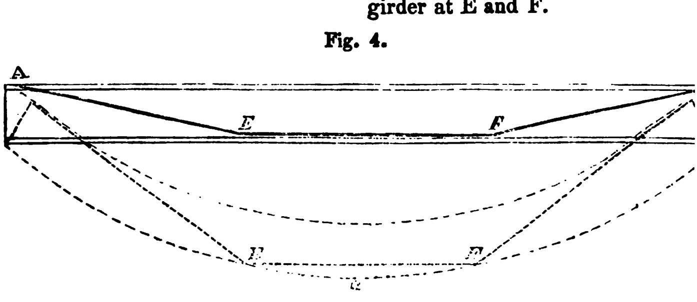
$$=\frac{T}{6b_1 d}\left\{b_1^2 n(d^3-d_3^3)-ms(2d_4+d)(6d-3b_1 d)\right\}-$$

In this investigation, I have not taken into consideration the action of the tension-rods upon the top flange, which resists a compression equal to the sum of the tension in the lower flange and tensile rods.

When the truss rods are not applied, we have seen that the amount of tension in the beam is greater than when they are applied, by reason of the portion that is resisted by the tensile bar EF, being at an increased depth (d_4) from the centre (c) to which the moments of the forces are referred. Therefore, in reality, the compression in the flange AB would be less with the rods than without them; yet it would be imprudent to economise material from this part of the beam, on account of the compression from the action of the tensile rods being throughout its whole length, from A to B; and as so long a bar, on compression, is apt to get crooked, it would be more advisable to add than to diminish fro upper flange.

It has been found by experiment a wrought iron bar of good materia one square inch in section, will, tension, extend about $\frac{1}{10000}$th of its l for every ton with which it is load am not clear upon the extension o iron, but it is not so great, and the of elasticity are much sooner pass the extension in both materials is a proportional to the load, and *vice* The strain is always proportional extension; but because under s pressures the extensions of wroug cast iron differ from each other, it i that in trussing a girder, ever should be so adjusted that the wr and cast iron may act independen each other. This cannot be the the truss is contained within the g and fixed to it, as in fig. 4, for th EF are here fastened to the points girder at E and F.

Fig. 4.



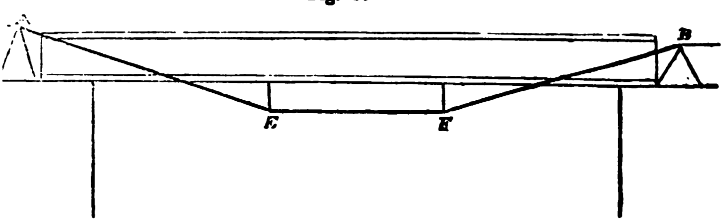
If the girder so trussed were deflected by the pressure p, it would be curv seen by the hollow lines.*

* This deflection is, of course, exaggerated.

w since EF is attached at the end F, the bar would form the ordi- f the curve EaF, and consequently not be so much extended as even ver flange of the cast iron girder.

It would, of course, be preferable if the upper ends of the truss rods, instead of being fixed to the upper flange of the beam, were carried over cast iron saddles, A and B, on the abutment, as in fig. 5.

Fig. 5.



props E F in the truss rods are hown to divide the girder into qual parts. Hence, if $2\,L =$ the length of the girder $\frac{2}{3}\,L =$ space Let μ be the load on each unit of $\frac{2}{3}\,L\,\mu =$ the load between each e equal spaces, or $\frac{1}{3}\,L\,\mu$ would resolved force on the props E and ence

$$\frac{1}{3}\,L\mu.\ \frac{1}{3}\,L = \frac{1}{9}\,L^2\mu =$$

ment of the superincumbent weight the central point in the neutral bout which (in the event of rup- the fractured ends would turn, as, substituting this for $P_1 p$ in on (4), we have

$$\mu = \frac{T\,b_1\,n}{6\,d}\left(d^3 - d^3_s\right)\ .\ .\ .\ (8)$$

Which shows the girder to be nin times stronger by such an arrangemen of tensile bars than it would be withou them.*

That the girder is stronger with the tensile bars so arranged, there can be no doubt; but as the above equation is constructed on the supposition of the whole being perfectly rigid, and as in practice this would not be the case, the results, as shown by the equation, would be considerably modified. For, if $\phi = \angle\,\mathrm{AE}a$, then $\frac{2\,L\,\mu}{3\sin\phi} =$ the tension on the bars AE and BF, and

Thus, then, if the extension of the bar, under pressure of one such section, be $\frac{1}{10000}$th of its length, and the expression $\frac{2\,L\,\mu}{3\sin\phi}$ represents the strain in tons, and $s =$ the section of the bar, then $\frac{2\,L\,\mu}{3s\sin\phi}.\ \frac{E\,F}{10000} =$ the extension of E F

$$\text{but } E\,F = \sqrt{(\mathrm{A}a)^2 + a\mathrm{E}^2} = \sqrt{\left(\frac{2}{3}\,L\right)^2 + (d + d_4)^2}$$

$$\text{when } \frac{2\,L\,\mu}{3s\sin\phi}\sqrt{\frac{(\frac{2}{3}L)^2 + (d + d_4)^2}{10{,}000}} + \sqrt{(\tfrac{2}{3}L)^2 + (d + d_4)^2} =$$

$$= \sqrt{(\tfrac{2}{3}L)^2 + (d + d^4)^2}\left\{1 + \frac{2\,L\,\mu}{30000\,s.\ \sin\phi}\right\} =$$

ngth of the bar E F after it was extended, but,

$$\overline{E\,F}^2 - \overline{\mathrm{A}a}^2 = \overline{a\mathrm{E}}^2$$

',

* ince $\mu =$ the weight on each unit of the length of the girder $\mu L = P_1$ and $L = p$—whence $P_1 p =$

$$\left\{ (\tfrac{1}{2}L)^2 + (d+d_4)^2 \right\} \left\{ 1 + \frac{2 L \mu}{30{,}000\, s. \sin \phi} \right\}^2 - (\tfrac{1}{2}L)^2 =$$

$$d+d_4)^2 + ((\tfrac{1}{2}L)^2 + (d+d_4)^2) \left\{ \frac{4 L \mu}{30{,}000\, s. \sin \phi} + \left(\frac{2 L \mu}{30{,}000\, s. \sin \phi} \right)^2 \right\}$$

but $\left(\frac{2 L \mu}{30{,}000\, s. \sin \phi} \right)^2$ is so small that it cannot possibly affect the result; w by omitting this, we have for the increased deflection of the bar A E, in the cal direction a E

$$\left\{ (d+d_4)^2 + \frac{4 L \mu}{30{,}000\, s. \sin \phi} \left((\tfrac{1}{2}L)^2 + (d+d_4)^2 \right) \right\}^{\frac{1}{2}} - d + d_4$$

and, consequently, would allow the girder to deflect at the points E and F extent, and would thereby modify the result shown by the above equations.

The conclusions we may draw from the preceding investigations are,—

1. That a girder, when judiciously trussed with tensile bars, is stronger than when not so trussed.

2. That the efficacy of the tensile bars greatly depends upon the manner in which they are applied to the girder. That the assistance they render is in proportion to their depth, or versed sine; and that their efficiency is still further increased by having the tensile bars entirely disconnected to the beam upper ends.

3. That in consequence of the ence of action of cast and wroug under such pressure considerab should be taken, in the applicatio trusses, that they should act in unif and as the above equations are con on the supposition of perfect rigi til the instant of rupture, calc founded on them should be mod the results of experiments.

AEROSTATION.

Sir,—Your correspondent, Mr. Pitter, is evidently a person of ingenuity; but he has not paid sufficient attention to the study of aeronautics. His applying the term "balloon" to the machine he has figured, is not correct, as the name, strictly speaking, is only applicable to a spherical body. To obviate an objection of this kind, the term "aerostat" was soon adopted by early aeronauts. They proposed the plan of a long, cylindrical aerostat, having conical ends; but there is the difficulty of keeping the prow pointed in the proper direction. When the machine turns the side instead of the prow to the desirable point, the cylindrical shape becomes a disadvantage. This defect has made many prefer the spherical balloon for attempts at directing.

There is a tendency of a balloon, or of a long aerostat, to turn on its vertical axis. Another difficulty is, the rapidity with which a balloon is swept to leeward by the wind, while oars or wheels, used to cause a deviation from the current, have little effect. A rudder has been found useless in attempts to steer, on account of a balloon moving as the wind. A rudder of a boat in river, is of no use, while the boa *exactly* as fast as the stream.

It may be safely asserted, tha der of any kind would be of littl keep Mr. Pitter's aerostat always in the proper direction. It is in him to talk of machinery, of room, and engine, without giv weight of the machinery, and ment of the cubic quantity of ga aerostat, so that its lifting power calculated. Many who have pai tation much attention, have com conclusion that steam power is nc it, on account of the weight of the and of the weight of the necess and water.

Condensed air is a prime m much force, but requires a r vessel of great strength, and conse of great weight. Mr. Pitter wou his furnace to consume its own but carbonic acid gas would be gi which would smother the aeronau the way the mouth of the chi placed below the upper cylindric

forcing an aerostat to any useful
from the line of a current, a power
than any known is desirable.
ter would have little faith in steam
pelling balloons, if he had read
onck Mason's "Aeronautica," or
ac Sweeny's "Essay on Aerial
tion." Of all prime movers, man
most powerful and effective, in
ay, in proportion to his weight.
mpts be made to impel balloons,
stion, therefore, is, in what way
power of man be employed to
the greatest effect?
ably men cannot produce useful
n any way, with more advantage,
the plan of warping balloons, to
leviation from a current. This
hich has engaged some attention
is looked on by many, conversant
erostation, as giving the best
for navigating the air.
ng aerostat has been often pro-
is the volumes of the *Mechanics'*
ine show; but the placing of gas-
eneath the deck on which Mr.
aeronauts are, would alter the
of gravity of the entire machine,
uld endanger its stability in an
position. *Powder-bags are dan-*
things near fire—gas-bags are
r.
Pitter does not appear to be aware
arachute, in the form of an in-
cone, has been proposed before.
ocking's parachute was on this
id his death was the consequence
ise—as the resistance of the air
cause such a parachute to col-
If, to prevent collapse, matters
gth and solidity be added, the
ite may be rendered so heavy, as
it unfit for the safe descent of an
t.
Pitter thinks, that if a cylinder
be very large, the machine will
unmanageable. In this opinion
ers from Sir George Cayley and
gh authorities on aerostation, who
d with just reason also, that there
reatest chance of directing when
s of vast size are employed.
e is one point on which all per-
ll agree,—the necessity of having
attached to the car of a balloon,
ent a violent shock on reaching
und when a balloon descends with
y. A precaution of this kind may
means of saving lives, and should
be constantly advocated, until the force of public opinion would oblige every aeronaut, in every country, to adopt so simple and efficacious a mode of insuring safety in case of a rapid descent.

I am, Sir, yours, &c.,

ARGUS.

July 15, 1847.

THE "COLLEGE OF PRECEPTORS."

Sir,—Many of my brethren have no doubt read, with as much satisfaction as I have, the strictures which have lately appeared in your Magazine, to which I have been a subscriber for many years; and we owe you an amount of thanks increased by the consideration that the subject was one which you might have passed by without any dereliction of your editorial responsibilities, and that you were led to wield your able pen in the defence of the scholastic profession, by the desire, often shown in your pages, of forwarding schemes which have true usefulness in view on the one hand, and on the other of exposing those which are not based on fairness and sound principles.

I have been more than once asked to join the "College of Preceptors" on the plea that it would be the means of providing us with better assistants, and would raise the schoolmasters' profession to the station it ought to hold in society; but the extreme arrogance of some of their earlier advertisements, and the conviction that neither of those ostensible purposes would be answered by a body so constituted, have ever prevented my enrolling myself in their ranks; and even the knowledge that at least one of the gentlemen, who take an active share in the management, is both a very worthy man and an excellent teacher, has failed to remove any of my objections. Mere neutrality, however, is not sufficient to arrest the progress of an undertaking which threatens no less than placing a yoke on our necks. The number of its members seems increasing: masters from the mistaken notion that they will thereby acquire a desirable status, and assistants for the sake of diplomas, bring their guineas to the capacious treasury; a charter is talked of, and if we remain absolutely passive, it is possible that a future Parliament may not consider that those schoolmasters that are not for the

college are against it. It behoves us then to be up and doing, to organize an opposition respectable in its numbers, and strenuous in its leaders, for the purpose of counteracting a mischief, which otherwise our continued supineness will assuredly allow to increase in magnitude and strength to a degree we shall have reason to regret.

To my thanks for the care you have taken, and which I trust you will continue to bestow on the subject, I should, but for the fear of being thought tedious, have added others for your papers on the "Use of Mathematical Knowledge," &c., and for the series just begun by Professor Davies: they are conceived in a truly Pestalozzian spirit, and can hardly fail to become eminently useful, not only by the positive knowledge they convey, but by thus teaching men the art of thinking.

I am, Sir, yours, &c.,

P. Sandoz.

Twickenham, July 24, 1847.

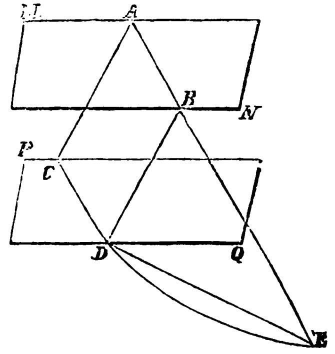
GEOMETRY OF THE LINE AND PLANE.—BY T. S. DAVIES, F.R.S., L. & E., F.S.A., ROYAL MILITARY ACADEMY, WOOLWICH.

(Continued from p. 38.)

Chap. II.—*Parallel Lines and Planes.*

Prop. I.

If two parallel planes be cut by a third plane, the sections will be parallel.



Let the parallel planes MN, PQ be cut by the plane AD: then the lines of section AB, CD will be parallel.

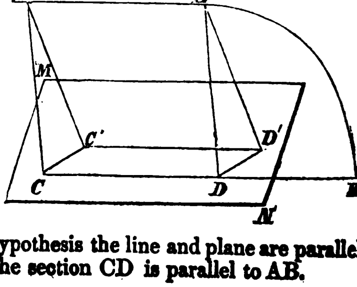
For, if AB, CD which are in one plane AD be not parallel they will meet in some point, as E.

Then, since AB lies wholly in the plane MN, and CD in the plane PQ, their intersection E is in both the planes MN, PQ; and hence those planes meet in E. But they are also, by hypothesis, parallel, and hence never meet (*def.* i.). Wherefore the lines AB, CD in which the same plane AD cuts MN, PQ can never meet: that is, they are parallel.

Note.—In the figure, the line CD is continued to E, in two different ways:—by a curve, and by a line, DE, which is not continuous of CD. The latter method is always adopted in the figures of "Euclid's Elements:" but the former appears to be the preferable method, as the eye at once detects the character of the argument (if such an expression may be allowed), which is founded on the absurdity of a line being at the same time hypothetically straight and visibly curved. It is, however, a matter of no moment, except as regards facility of apprehension; and it is only referred to, to remark that, as far as my own experience goes, I am led to prefer the curve.

Prop. II.

If a straight line be parallel to a plane, all planes drawn through the line to cut that plane will have their sections with it parallel to that line and to one another.



Let the line AB be parallel to the plane MN, and planes AD, AD′ be drawn through AB to intersect MN in CD, C′D′: then CD, CD′ will be parallel to AB and to one another.

(1). Since AB, CD are in one plane AD, they are either parallel to one another, or they will meet in some point E.

If parallel the proposition is admitted. But if not, then since CD lies wholly in the plane MN, and AB meets CD in E, the line AB meets the plane MN: whilst by hypothesis the line and plane are parallel, and can therefore never meet. Wherefore the section CD is parallel to AB.

(2). The planes AD, AD′ intersecting in the line AB, cannot meet in any other point. Whence the lines CD, C′D′ in them can never meet (*ax.* 10). But these lines CD, C′D′ are in one plane MN; and never meeting, they are parallel.

PROP. III.

If a line without a plane be parallel to a line in that plane, the first line will be parallel to the plane.

Let the line AB without the plane MN be parallel to the line CD in it: then AB will be parallel to the plane MN.

For, since AB, CD are parallel they are in one plane AD, and AB, CD can never meet; and since AD, MN meet in CD, they cannot meet in any point without CD (*ax.* 10). Whence AB, it lying wholly in the plane ACD, can never meet the plane MN: that is, the line AB is parallel to the plane MN.

COROLLARY.

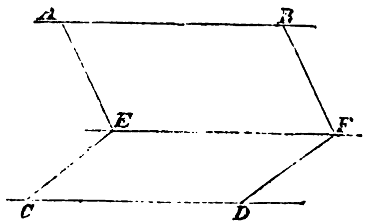
If through CD, one of two parallel lines AB, CD, any plane MN be drawn, this plane will either wholly include the line AB or be parallel to it.

PROP. IV.

If through two parallel lines any planes be drawn, they will either coalesce, be parallel, or have their line of section parallel to those two lines.

(1). The planes may be each drawn through the other line, since parallel lines lie wholly in one plane; and hence would coalesce with the plane which contains the parallels, and consequently with each other.

(2). The planes may never meet, and hence would be parallel.



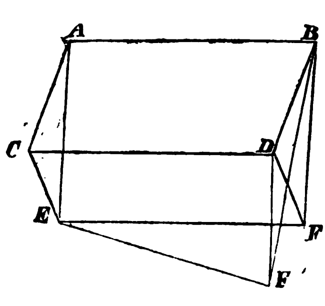
(3). Let AB, CD, be parallel lines, through which are drawn any two planes AF, CF which neither coalesce nor are parallel; then their section EF of these planes will be parallel to the lines AB, CD.

For since AB is parallel to the line CD lying in the plane ED, it is parallel to the plane ED itself (*prop.* 3.); and hence it can never meet the line EF in that plane. But EF is also in the plane AF, since it is the intersection of that plane with the plane ED; and hence AB, EF being in the same plane and never meeting, EF is parallel to AB.

In the same way it is shown that EF is parallel to CD.

PROP. V.

If lines be drawn, one in each of two planes which intersect and both parallel to that intersection, these two lines will be in one plane and parallel to each other.



Let the planes AD, DE intersect in CD, and let AB and EF in those planes respectively be drawn parallel to CD: then AB, EF will be in one plane and parallel to one another.

(1). If AB, EF be not in one plane, draw a plane through AB and E to cut the plane CF in EF′. Then since through the parallels AB, CD planes are drawn which intersect in EF′, this line (EF′) is parallel to CD (*prop.* 4.) But (*hypoth.*) EF is parallel to CD; and hence through the same point E two parallels EF, EF′ can be drawn to the same line CD, which is impossible. Where-

fore the plane through AB and E includes the entire line EF; that is, the two lines AB, EF are in one plane.

(2). Again, since CD is parallel to the line AB in the plane ABFE, it is parallel to the plane itself (*prop.* 3.); and since through the line CD which is parallel to the plane ABFE planes are drawn which cut it in AB, EF, these lines are parallel to one another.

PROP. VI.

If two straight be each of them parallel to a third line, though this be not in the same plane with them, they will be parallel to one another.

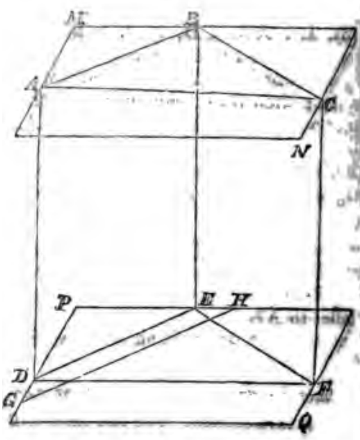
Let AB and EF be parallel to CD, though not all three in the same plane, then AB will be parallel to EF.

For since AB, CD are parallel they are in one plane; and similarly EF, CD are in one plane. These planes meeting in CD, and the lines AB, EF being parallel to their intersection, these lines are parallel to one another (*prop.* 5).

PROP. VII.

If two straight lines which meet be parallel to two others which meet, but not in the same plane with them: the plane which contains the first two will be parallel to the plane which contains the others; and the angle contained by the first two will be equal to the angle contained by the others.

Let AB, BC be parallel respectively to DE, DF: then the plane MN drawn through AB, AC will be parallel to the plane PQ drawn through DE, DF; and the angle BAC will be equal to the angle EDF.



(1.) For if the plane MN be not parallel to PQ, it will cut PQ in a line, which suppose to be GH.

Then since AB is parallel to DE a line in the plane PQ it is itself parallel to PQ (*prop.* 3); and since the plane MN is drawn through a line AB, which is parallel to PQ and cuts PQ in GH, the line GH is parallel to AB (*prop.* 2).

Again, since through DF which is parallel to AC the plane PQ is drawn, the line AC is parallel to PQ; and since the plane MN passes through AC and cuts PQ in GH, the line GH is parallel to AC.

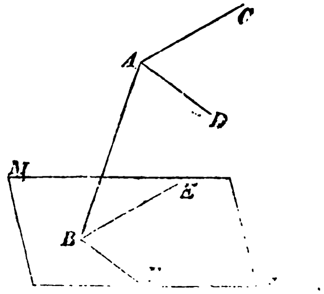
Wherefore AB, AC are both parallel to the same line GH, which is impossible. The planes MN, PQ do not therefore meet in GH; and in the same way they cannot meet in any other line. Whence they are parallel.

(2.) Take AB equal to DE and AC to DF, and join BC, EF, AD, BE, and CF. Then since AB is equal and parallel to DE, they are in the same plane, and AD is equal and parallel to BE (*Euc.* i. 33). For a similar reason AD is equal and parallel to CF. Also, since BE, CF are parallel to AD, they are parallel to one another (*prop.* 6); and they have been proved equal. Whence BC is equal to EF.

Moreover, since the two sides BA, AC are equal to the two ED, DF, and the base BC to the base EF, the angle BAC is equal to the angle EDF (*Euc.* i. 8).

Prop. VIII.

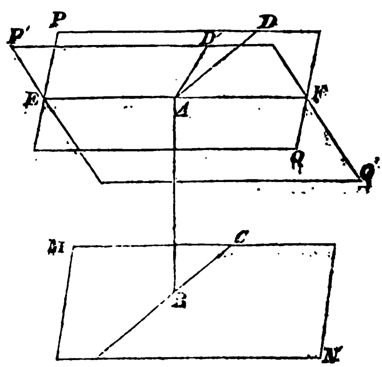
Through the same point without a plane, innumerable lines can be drawn parallel to the plane: but through that point only one plane parallel to the given one: and all the lines parallel to the plane will lie in the plane parallel to it.



Let MN be a plane and A a point without it;—then through A innumerable lines AC, AD, *etc.*, may be drawn, all of which may be parallel to MN: only one plane can be drawn through A parallel to MN: and that plane will contain all the forenamed lines, AC, AD, *etc.*

(1.) Draw any line AB to meet the plane MN in B; and through AB describe any number of planes ABE, ABF, *etc.*, cutting MN in BE, BF, *etc.* In these planes draw AC parallel to BE, AD parallel to BF, *etc.*

Then since AC is parallel to a line BE in the plane MN, it will be parallel to the plane MN. In the same manner AD is parallel to the plane MN; and the same reasoning applies to all other lines drawn through A parallel to lines drawn in the plane MN through B. The first part of the proposition is, therefore, true.



(2.) There can be but one plane drawn through A parallel to MN.

For if it be possible, let there be two planes PQ, P′Q′ drawn through A parallel to MN, and intersecting in EF. This line will pass through A, since both the planes PQ, P′Q′ do so. Draw through A, any plane not coinciding with EF to cut MN in BC, PQ in AD, and P′Q′ in AD′. Then since the parallel planes MN, PQ are parallel and cut by a third plane in BC, AD respectively, these lines are parallel (*prop.* 1); and similarly BC, AD′ are parallel. Whence through the same point A two lines AD, AD′ can be drawn parallel to BC; which is impossible. Wherefore, only one plane can be drawn through A parallel to MN.

(3.) All lines through A parallel to MN lie in the plane PQ parallel to MN.

For, if possible, let any line as AD′ which is parallel to MN not lie in the plane MN. Through this draw any plane to cut MN, PQ in AD, BC; and join AB, B being any point in BC.

Then AD, BC are parallel (*prop.* 1), and AD′ is in the same plane with them. Whence AD′ cannot be parallel to BC, and must therefore meet it. But BC is in the plane MN, and hence AD′ will also meet that plane. No line AD′, therefore, out of the plane PQ can be parallel to the plane MN; and it hence follows, that all the lines which are parallel to MN and pass through the point A lie in the plane PQ which is drawn parallel to MN.

Corollary 1.

Any line drawn in one of two parallel planes will be parallel to the other plane.

Corollary 2.

If a straight line be parallel to a plane, a plane can be always drawn through it parallel to the plane; and there can be only one such plane drawn.

Prop. IX.

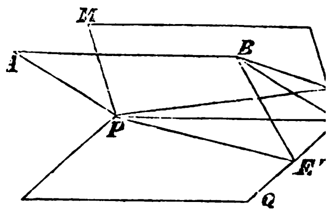
If a line be parallel to the intersection of two planes it will be parallel to each the planes; and if a line be parallel to two planes it will be parallel to th intersection.

(1.) Let the two planes MN, PQ intersect in PN, and AB be a line parallel to PN: then AB will be parallel to both the planes MN, PQ.

For, since AB, PN are parallel, and the plane MN passes through one of them PN, the line AB is parallel to the plane MN (*prop.* 2). In like manner it can be shown to be parallel to the plane PQ.

(2.) Let the line AB be parallel to each of the planes MN, PQ; it will be parallel to their intersection PN.

For, through AB and any point P in the intersection PN, let a plane be drawn; and if it do not wholly coi



with PN, let it cut the planes MN, in PE, PF.

Then, since through AB, which is parallel to the plane MN, a plane ABEI been drawn, the section PE is parallel to AB (*prop.* 2). For a similar re PF is parallel to AB. Whence through the point P two lines PE, PF can be di parallel to the same line AB; which is impossible.

The line PN is, therefore, in the same plane with AB; and since AB is pa to the plane with which PN coincides, it can never meet PN. Whence A parallel to PN.

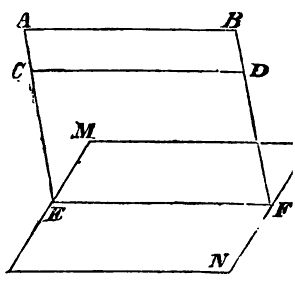
Prop. X.

If a plane be parallel to one of two parallel lines, or to one of two parallel planes, will be parallel to the other.

(1.) Let the plane MN be parallel to one, AB, of the parallel lines AB, CD: then it will be parallel to the other CD.

For, since AB, CD are parallel they are in one plane: and this plane is either parallel to MN, or will cut it in some line EF.

If ABCD be parallel to MN, the plane MN is parallel to every line CD in ABCD. (*prop.* 8, *cor.* 1.). Whence in this case the proposition is true.

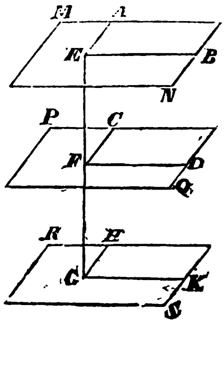


But let the plane ABCD cut MN in the line EF. Then, since MN is parall AB, the line EF is also parallel to AB (*prop.* 2). Also (*hypoth.*) CD is parall AB; and hence CD is parallel to EF in the plane MN. Wherefore the plane is parallel to CD (*prop.* 3). The theorem is, therefore, true.

(2). Let the planes MN and PQ be each of them parallel to RS: they will be parallel to one another.

For, in the extreme planes MN, RS take points E, G, and join EG. This will necessarily cut the intermediate plane PQ in some point F.

Through EG draw any two planes, cutting MN in EA and EB, PQ in FC and FD, and RS in GH and GK.

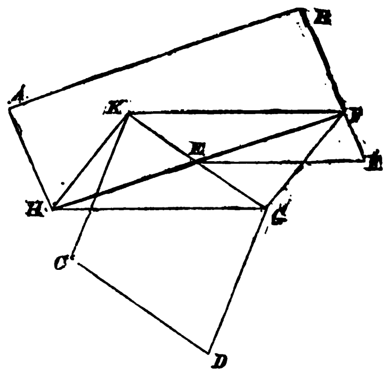


Then since MN is parallel to RS, the sections EA, GH are parallel (*prop.* 1.); and for a similar reason the sections FC, GH are parallel. Wherefore EA, FC are also parallel to one another.

In the same way it may be shown that EB, FD are each parallel to GK, and therefore to one another. Whence also, the planes MN, PQ in which these parallel lines are respectively situated, are also parallel to one another. (*Prop.* 8).

PROP. XI.

Through a given point only one plane can be drawn parallel to two given lines which are not themselves parallel: but when the given lines are parallel, innumerable planes may be drawn parallel to both of them.



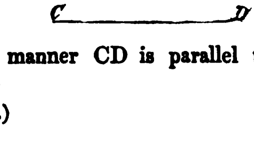
(1). Let AB, CD not be parallel (though in the same plane or not) and let E be any point whatever: then through E one plane, and only one, can be drawn which shall be parallel both to AB and CD.

Through E one line EF, and one only, can be drawn parallel to AB; and one, and one only, parallel to CD.

The line AB being parallel to the line EF, is parallel to the plane GEF in which EF is situated. Similarly CD is parallel to the plane GEF. Wherefore the plane GEF is parallel to both the lines AB, CD; and hence one plane can be drawn through E parallel both to AB and CD.

Nor can there be drawn any other plane parallel to AB and CD. For, if there can, let it cut the plane through AB and E in the line EF′.

Then since AB is parallel to the second plane, the section EF′ is parallel to AB (*prop.* 2). But EF is also parallel to AB. Whence through E two lines EF, EF′ can be drawn parallel to AB: which is impossible (*ax.* 11). Wherefore no other plane besides GEF can be drawn parallel to AB and CD.



(2). Let the lines AB, CD be parallel: then innumerable planes may be drawn through E parallel to both of them, whether E be in the same plane with them or not.

For, through E draw a line FG parallel to AB; it will also be parallel to CD. Through FG draw any plane MN: this will be parallel to AB and CD.

For, since AB is parallel to FG a line in the plane MN it is parallel to the plane MN itself (*prop.* 3). In the same manner CD is parallel to MN. That is, the plane MN is parallel to AB and CD.

(*To be continued.*)

ENGINEERING AT THE ROYAL AGRICULTURAL SHOW, NORTHAMPTON.

Sir,—The application of steam power to purposes of agriculture is almost a new feature in the annals of modern progress, and, as such, is worthy of attention by all who have the growing interests of the community at heart.

The Royal Agricultural Society of England held its meeting this year at Northampton; and one of its greatest features was the number of portable steam-engines, as applicable to thrashing and other purposes.

The whole of the steam-engines (seven in number), with their accompanying thrashing-machines, were placed in the trial yard (adjoining the large implement yard), where excellent arrangements had been made for their reception. A large quantity of corn, in the straw, was provided, and coals for getting up the steam and working the various engines during the intended trial.

The result of this so-called *trial* has been anything but fair to those persons who exhibited steam engines, and far from satisfactory to the public.

I enclose you a copy of three resolutions adopted by the unsuccessful exhibitors, which, you will observe, do not contain merely the objections of one or two individuals, but are the unanimous protest, on common ground, of all parties concerned, and will be sufficient to show, without any comment from me, the uniform dissatisfaction created by the award of the judges. I beg, however, to offer a few observations relative to the arrangements for the trial—not by any means with a view to stir up ill feeling, but to prevent the recurrence of superficial investigation, and consequent error, on future occasions.

The Society offer in their list of prizes, "For the *best* portable or fixed steam-engine, applicable to threshing, and other agricultural purposes, 50*l.*"

The parties appointed to investigate the merits of these engines, were *two farmers!* Now, without disparaging the general scientific knowledge and abilities of these gentlemen in agricultural matters, it does appear out of place that they should have been chosen to examine the details and test the capabilities of steam-engines.

The impropriety of such an arrangement is abundantly evident from the following facts:—Each of the engines exhibited was different in construction and mode of working from the others; and ten minutes was all the time that these off-hand gentlemen allowed themselves for their elaborate experiments with each engine. No account was taken as to the time in getting up the steam, consumption of fuel, the working pressure as consistent with safety, comparative security from fire, and other important details of mechanical arrangement.

As might be expected, the prices of these engines varied, according t size, construction, and general a tages of each; but all those imp properties, so necessary to the ef and profitable employment of power, and which a practical en would take first into consideration entirely unappreciated by the a tural gentlemen who undertook th posal of the Society's prize for the " *steam-engine*," and who awarded the one *lowest in price*, withou other apparent consideration.

I hope the dissatisfaction so manifested this year, will tend t prove the practice of the Council i future trials of machinery; feelin convinced that no method could b certain to lessen the extent and u ness of the Society than such futi inefficient regulations.

Yours, respectfully,

J. SAM

Northampton, July 27, 1847.

The Resolutions.

At a Meeting of the *Exhibiters of Engines*, at the Royal Agricultural of England's Meeting at Northampto this 21st day of July, 1847,

PRESENT:

Mr. OGG, Jun. of Northampton, in th
Messrs. BARRET, ASHTON, & Co., o
Mr. WILLIAM BLOXOM, of Gillmort
Messrs. Ryland and Dean, of Birmi
Mr. JOHNSON, of Leicester, for S
Mr. J. W. SHARMON, of Wellingb and Mr. W. P. STANLEY, of borough;

It was resolved unanimously,

1st. That, in the opinion of this m the Judges are chargeable with great i towards the unsuccessful Exhibiters o Engines, in awarding the Prize of 5 fered by the Society for the best Engine, to the one, of all those ex which this meeting considers as th entitled to the Prize; and that, bea mind the determination *so emphatic* pressed by the Judges, to pay *par attention* to the consumption of Fu the Pressure of Steam, Strength and city of Boiler, and to all points affect safety of the public, this meeting is a to account for so *flagrant a violation* principles, as the award of the Pri engine which (it was notorious) co nearly *twice the quantity of coal* t others exhibited, was working at a p exceeding 80 lbs. per inch, and at t of 240 to 250 revolutions per min

of which (as could only be anticipated) : partial destruction of the Thrashing ne, at the imminent danger of all employed about it.

That this meeting is further of ., that a *palpable deception* has been ed upon the Judges in the entry of mbridge's Steam Engine as one of *ree Power:* whereas the capacity of inder, viz. 6 inches diameter, with 12-inch stroke, are but equivalent highest pressure that may be cones safe in the hands of inexperienced) to about *Three-horse Power.* erroneous impression is thereby as to the *relative Price* of the End that under these circumstances, Engine is *disqualified for competing,* refore *not entitled to the Prize.*

That this meeting is much disap- that the disposal of the Prize for Engines was not deputed to Mr. , or some other acknowledged practi competent Engineer; and express termination never to exhibit a Steam at the future meetings of the Society, ch arrangements shall be made as re an *ample trial* and a *proper ad-*ms.

DEMONSTRATION OF THE PARAL-GRAM OF FORCES IN POISSON'S IANICS.

In the excellent and instructive a this demonstration, by J. J., of contained in pp. 38—40 of the volume of your Magazine, we

$\frac{\phi z}{\iota z}$ = constant = c; and after

g the value of ϕ x, the *substitu-* : = — a^2, gives ϕ x = 2 cos. ax.

perusing these notes, it occurred whether an assumption could not e which would give ϕ x *without tion,* and on referring to Dr. excellent "Treatise of Mechailosophy," I find it already done

ming $\frac{d^2\phi z}{\phi z dz}$ = — m^2. If the ossess sufficient interest to merit n your pages, their insertion will blige

Yours respectfully,

THOMAS WILKINSON.

Lancashire, July 24, 1847.

Allow me to add, that Professor gives a demonstration little differ- t that by "J. J.," in his "Elements of Mechanics;" a work which, it appears, is not known to the learned writer of the "Remarks on the Use of Mathematical Knowledge to Engineers," but which, I think, would well bear comparison with some of the treatises he has enumerated.

T. W.

RAILWAYS—SUGGESTIONS FOR THEIR SAFER CONSTRUCTION.

SIR, — Allow me to tender my grateful thanks for your kindly inserting my humble opinions relating to the construction of railways, &c. I herewith send you the copy of the *Sun* newspaper; and although it is two years since it first saw the light, I still am of the same opinion as regards the utility of the plan therein developed. Should you deem it worthy a place in your intelligent Magazine, I should feel myself highly honoured.

I am, Mr. Editor,

Yours most thankfully,

JOHN SUTTON,

42, Stamford-street, formerly of
14, Crown-row, Walworth-road.
July 12th, 1847.

"*To the Editor of the Sun.*

"Sir,—Would you allow me, through your journal, to call the attention of the chairmen of the various committees on railways to strongly enforce, in their Reports to the House, of such lines as they may think worthy of adoption, the positive necessity of compelling all future lines to have safety flange-rails, on the old-fashioned tram-rail principle; thereby avoiding all possibility of accident by the trains getting off the line, and moreover preventing most serious consequences, should two trains meet or run into each other. The present rate of velocity, though it may be 50 miles an hour, is but slow work to what it will be, some five years hence, and as such, something ought to be done to compel the companies to make the lines safe, without the least possibility of accident—thereby ensuring confidence in the public mind, and a corresponding increasing traffic for the benefit of the shareholders. It is no joke to travel in fear, and be only at ease when you arrive safe at your journey's end. A day will come when some most disastrous accident will happen to the highly born, and then, no doubt, amendment will follow. Few, very few, are aware upon what a narrow edge or brink they are travelling, and that a mere flanch, not more than an inch and a quarter deep, from the sole of the wheel, is all the security they have of the train keeping within the rails.

Moreover, the wheel, in its rapid revolution, is exerting itself with all its might at every oblique movement of the carriage, to get this narrow flanch over the rail, and were it not for the downward pressure, it would very soon accomplish.

"Engineers prefer edgerails to tramrails, because they look nicer to the eye, though they know full well the tramrails may be made quite as strong—I say stronger than the edgerails. Now, Mr. Editor, as I cannot give you a diagram, I will explain myself thus briefly:—Take a bit of paper, the length no matter, but the width must be, say 28 inches. Now, fold the paper longitudinally, 12 inches from the outer edge; turn the paper over and fold this side also 12 inches from the outer edge. Now, the two folds will be back to back, and if you open these folds, you will have a settee-like form of rail, consisting of a back or flange 12 inches deep, a seat or level surface 4 inches wide, and a bottom or lower flange 12 inches deep. Now, if you turn the paper over, you still will have the same form presented to you; thus proving that the rail will possess a most everlasting wear, as, when the upper side is injured or worn, it may be turned over, and what was underneath will in like turn become the future rail. Upon the 4-inch level surface or ledge the soles of the wheel will rest or travel, having a high flange facing their outer side, and a corresponding one downward inside. These rails may be either fixed in chairs, or else fastened to the sleepers by screw bolts. There must be on the outer side of the upper flange brackets or stays, fastened at their upper part to the flange, and at their lower part to a cross sleeper; and thus we shall have, as it were, a trunk or channel railway, with an utter impossibility of the train ever getting or running off the line, as it will be kept from swerving to the right or left by the upper flange. The outer edge of the sole of the wheel need not touch the upper flange, thereby avoiding friction, but the upper flange will present to the wheel, should it be inclined to swerve by its rapid progress, a butt, or throw-off, which the wheel would merely play, as it were, against, but over which it could not go, for the want of a direct bite. These high flanges may be either erect or outwardly inclined a little. This channel railway, as I shall call it, is not intended to supersede the flange of the wheels, but they ought to be made a little deeper; their present depth is quite inadequate to their purpose, viz. keeping the train on the line. Now, should this channel railway be not approved of, then let the present flimsy rails remain; but, for the safety of all, let there be flanges bolted on to the inner side of each wheel, full 12 to 14 inches in depth. Never mind the look, so we, the travellers, are safe. These flanges may be slightly tapering towards their outer edge, so as to avoid unnecessary friction.

"With these remarks we will have done, except to draw the following conclusions:—First. That with these alterations there will be an utter impossibility of the trains leaving the line, either by jumping, jolting, hopping, or bounding, or oscillating: or should two trains meet, their headlong butt will be in a straight line, not as it is at present, sideways. But one thing will happen with these alterations, through the present imperfect mode of placing the buffer-springs: the two engines, the moment they meet, will rear up, ram-like, both by their own impetus, and that of the hinder carriages pressing hard upon them; but if the buffer-springs were placed higher up, say two-thirds from the ground, they not only would not trip or rear up, but could not run into or over each other, but each carriage would receive no more than the amount of shock due to that carriage, according to its distance from the point of collision, as it will be no more than a very severe thrust, and not an overturning shock. This part deserves very great attention, as the buffers, which are intended to ease, if not avoid, a casualty, are the very things, through their being misplaced, that cause the overthrow of the carriages. Again, I do not see why there should not be eight buffer springs to each carriage, four in front and four behind, placed thus,—two in front, one on each side, one-third from the ground, the other two front ones, one on each side, one-third from the top; but these top ones ought to be a little longer than the bottom, so that they may receive the shock first. Now, the hinder ones are to be placed in the same manner; and if these buffers are furnished with a plug and key sort of adjustment, they may, when a severe shock takes place, become firmly keyed or locked into each other; and thus the whole line of carriages, at least those who are in the vicinity of the shock, will become as one body immovable, no running over each other or overturning; as they are as one carriage firmly united with the buffers, but which may be instantly disconnected by suitable gear.

"Note.—The accident that happened this week on the Great Western Line to the rapid train was caused by the jumping, or hopping to and fro swerve of the carriages, through there being no stay flanch to the rails, but merely the foolish inch flanch of the wheels. Many will say the flange rail

too expensive for the companies to I say, No; a very great saving will om it, not only by no accident ever ng of any moment, and, therefore, nse in repairs, but a very great in- f passengers will take place, through t confidence the people will have in nel railway.

'I am, Mr. Editor,

" Yours respectfully,

" JOHN SUTTON.

rown-court, Walworth, June 20th, 1845."

(July 12th, 1847.) The thought urally arise, How are the buffers to o each other when the train is at a I would humbly suggest, that to is objection, the key, or tongue, or it would be more explicit to call it le buffer (and the one it enters or ito, the female buffer)—I say that le buffer should have a side or hori- o and fro play, (not up and down,) ght degree, so as to adapt itself to ve of the rail. A very little side will be necessary, as two carriages or locked together will have to de- t a very little from the straight line ormation of any curve that ought to And as regards any up and down in these locking buffers, it must depend upon the relative situation ness or laxity of the springs.

AR OF SPECIFICATIONS OF PATENTS INVENTIONS. FROM THE PERIOD N THE PRACTICE OF ENROLMENT ENCED TO THE PRESENT TIME.— INUED FROM P. 94.

he Reports of the Deputy-Keeper of the blic Records (Sir Francis Palgrave).]

THE CALENDAR.

e two dates annexed to each entry, the e date of the patent, and the second that rolment of the specification.]

Harmer, of Sheffield, clerk: of a e for raising a shag on all sorts of cloths, and cropping or shearing which together come under the de- n of dressing woollen cloths, and r cropping or shearing fustians. 27 Geo. 3, p. 17, No. 14. March Geo. 3; April 10, 1787, 27 Geo. 3.

nas Sandys, of Bristol, lace and fringe cturer: of a machine for throwing and ing of silk, and for throwing and g of worsted, mohair, thread, cotton, flax, and gold and silver cords. Cl. Geo. 3, p. 18, No. 9. May 19, 27 ; June 2, 1787.

Wright, of Thurnscoe (York), far- or a drill plough of an entire new construction, calculated for the purpose of sowing all kinds of pulse, grain, and seeds in such a manner as will save expense in the cultivation of land, and at the same time in the manuring thereof. Cl. R., 27 Geo. 3, p. 18, No. 1. July 3, 27 Geo. 3; certified July 28, 1787.

William Purnell, of Dursley (Gloucester), iron master: of an invention of an entir- new mode of preparing, shingling and welding iron with pit-coal from the ore, as also from sow or pig metal, and every other sort of cast iron, entirely by the application of a machine constructed and applied as to render it of a superior quality and in much greater quantities, and with a very considerable less expense of fuel and waste of metal than hath hitherto been done by any method yet used. Cl. R., 27 Geo. 3, p. 19, No. 1. June 5, 27 Geo. 3; June 27, 1787.

William Cooper, of Sheffield (York), tallow chandler: of a machine for cleaning, spreading, twisting, and cutting cotton and making wicks for candles. Cl. R., 27 Geo. 3, p. 21, No. 9. August 11, last; September 5, 1787.

Nathaniel Watts, of Stroud (Gloucester), clothier: of a new method of dying in boiling liquors woollen cloth, or such articles as are composed chiefly of woollen in various devices representing foliages, scrolls, lines, and any other adapted forms, and this in pieces of sufficient size for the foreparts of a waistcoat or vest (viz.,), from eight to sixteen nails long, and from five to ten broad, which is effected by means of certain frames and moulds made of hard metals. Cl. R., 27 Geo. 3, p. 24, No. 3. Nov. 22, 28 Geo. 3; Dec. 17, 1787.

Joseph Rabone, of Birmingham, button maker: of a new method of making and manufacturing coat and waistcoat buttons of black or of any other colour or mixture of colours both plain and figured out of or from bone and ivory. Cl. R., 27 Geo. 3, p. 25, No. 5. January 14, 27 Geo. 3; Feb. 6, 1787, 27 Geo. 3.

Richard Fishwick, of Elswick (Northumberland), white lead maker: of a new method of making white lead. Cl. R., 27 Geo. 3, p. 25, No. 4. Jan. 15 last past; Feb. 14, 1787, 27 Geo. 3.

Robert Hickman, of Edgbaston (Warwick), button maker: of a method of making and manufacturing gilt and plated coat and waistcoat buttons by uniting or amalgamating with or by means of tin and lead, mixed gilt and plated metal button shells, both coloured, plain, and figured, with bottoms of copper, brass, iron, mixed and compound metals. Cl. R., 27 Geo. 3, p. 25, No. 3. Feb. 1, instant, 27 Geo. 3; February 20, 27 Geo. 3, 1787.

John Miles, of Birmingham, gent.: of an invention of making lamps in different forms and of any kind of metal or metallic substances, to be used without inconvenience on horses, carriages, breasts of men, or any body under motion, so as to give perfect light though ever so much agitated, or to be used in halls, on staircases, tables, desks, or for other purposes where motion is not required. Cl. R., 27 Geo. 3, p. 26, No. 7. Feburary 12, 27 Geo. 3; March 7, 27 Geo. 3, 1787.

James Storey of Tynemouth, esq.: of a certain machine for drawing and raising of water out of mines, and for other purposes. Cl. R., 27 Geo. 3, p. 28, No. 14. May 10, 27 Geo. 3; May 26, 27 Geo. 3, 1787.

James Alston, of Birmingham, buckle and button maker: of a new manner of making buttons of iron or steel covered with tin and other metal, or tin alone. Cl. R., 27 Geo. 3, p. 31, No. 1. Oct. 30, 28 Geo. 3; Nov. 26, 1787.

(*To be continued.*)

LIST OF ENGLISH PATENTS GRANTED ON JULY, 24 TO JULY 29, 1847.

John Platt, of Oldham, Lancashire, and Thomas Palmer, of the same place, for certain improvements in machinery or apparatus for making cards, also for preparing and spinning cotton and other fibrous materials, and for preparing and dressing yarn, and weaving the same. July 24; six months.

Charles De Bergue, of Arthur-street West, City, for improvements in buffing and traction apparatus, and in springs for railway and other carriages. July 26; six months.

Alfred Ceal, of Aldgate, manufacturer, and Henry Bear, of New-road, manufacturer, for improvements in the manufacture of tobacco. July 28; six months.

Edward Ryan, of Park-place, Bayswater, Middlesex, for improvements in consuming the smoke and economizing the fuel of steam-engines, breweries, and manufactories generally. July 28; six months.

James Morison, of Paisley, shawl manufacturer, for improvements in applying power in propelling or moving carriages, and in giving motion to machinery. July 29; six months.

Joseph Paul, of Thorp Abbott's-hall, Norfolk, farmer, for improvements in cutting or forming drains in land, and for raising subsoils to the surface of land. July 29; six months.

Francis Starr, of Warwick, for a new jet for the delivery of water and other fluids, which he styles the "Protean Jet." July 29; six months.

William Baines, of Norwich, inspector of railways, for improvements in the manufacture of parts of railways, and in the bearings of machinery, and in apparatus used in constructing railways. July 29; six months.

Alfred Vincent Newton, of 66, Chancery-lane, mechanical draughtsman, for an improved kiln, or oven, for firing porcelain and other similar ware. July 29; six months.

William Phillips Parker, of 48, Lime-street, City, gent., for an improved mode of manufacturing cigars. July 29; six months.

George Witherell, of New York, America, for improvements in manufacturing or working iron for various useful purposes. July 29; six months.

Stopford Thomas Jones, of Stamford-street, Surrey, for improvements in steam-engines, and in machinery for propelling vessels. July 29; six months.

John Hastie, of Greenock, Scotland, engineer, for improvements in the application of steam power to turn certain kinds of mills or machines with a continuous rotary motion. July 29; six months.

MONTHLY LIST OF PATENTS GRANTED FOR SCOTLAND FROM THE 23RD OF JUNE TO THE 31ST OF JULY, 1847.

William Darling, of Glasgow, ironmonger, for improvements in moulding, and in the manufacture of certain articles of cast iron. June 23.

Thomas Craddock, of Birmingham, Warwick, engineer, for improvements in steam-engines and boilers, and in machinery connected therewith. June 23.

Clemence Augustus Kurtz, of Manchester, Lancaster, manufacturing chemist, for improvements in the mode of preparing and using indigo in the dyeing and printing of woollen, cotton, and other fabrics. June 29.

Clemence Augustus Kurtz, of Manchester, Lancaster, manufacturing chemist, for a new manufacture of certain colouring matter to be used in the dyeing, or in the printing of woollen, cotton, silk, and other fabrics. June 29.

William Knowelden, of Great Guildford-street, Southwark, engineer, for improvements in steam engines. June 30.

John Shaw, of Blackburn, Lancaster, manager, for certain improvements in machinery or apparatus for carding, drawing, slubbing, and roving cotton, wool, and other fibrous substances. July 1.

Paul Gilbert Prellier, of Rue des Rivoli, Paris, in the kingdom of France, gent., for improvements in the manufacture of dry sulphuric acid, and in the manufacture of smoking or nordhausen sulphuric acid. (Being a communication from abroad.) July 9.

George Winslow, now of Boston, in the state of Massachusets and United States of America, merchant, but lately of Burton Crescent, Middlesex, for improvements in machinery for manufacturing files and rasps. (Being a communication from abroad.) July 12.

John Law, of York-place, Portman-square, Middlesex, gent., for improvements in yarns and in the machinery by which the same are manufactured. (Being a communication from abroad.) July 18.

William Edward Newton, of 66, Chancery-lane, Middlesex, civil engineer, for improvements in the manufacture of screws. (Being a communication from abroad.) July 19.

Henry John Nicoll, of No. 114, Regent-street, Middlesex, tailor, for improvements in garments, in pockets, bags, and other receptacles. July 19.

Edward Slaughter, of Avonside Iron Works, Bristol, engineer, for improvements in locomotive engines. July 20.

William Broadbent, of Manchester, and of Little Lever, both of Lancaster, paper manufacturer and dealer, for improvements in the manufacture of paper. July 21.

James Johnstone, of Willow-park, Greenock, esq., for certain improvements in the manufacture of sugar. July 21.

Egbert Hedge, formerly residing at 7, Howard-street, Saint Clement's Danes, Middlesex, now residing at the Commercial Hotel, Blackfriar's-road, Surrey, gent., for certain improvements in rails for railways, and in the manner of securing them. July 22.

William Breynton, of the Inner Temple, London, esq., for certain improvements in rotary steam engines, and in the means of working the same. July 21.

DESIGNS FOR ARTICLES OF UTILITY REGISTERED UNDER 6 AND 7 VIC. CAP. 65

No. in the Register.	Proprietors' Names.	Address.	Subject of Design.
1145	Walter Neilson and William Tate	Hyde-park Foundry Glasgow	Railway wheel spoke binding machine.
1146	James Buchanan	Glasgow	Ventilating case for wet umbrellas.
1147	Philemon Augustin Morley	Birmingham	Iron hoop for sugar moulds.
1148	John Cole	Boston, Lincolnshire, gunmaker	Breech for firearms.
1149	Thomas Saddleton Reeler	Cornwall-place, Brecknock-street	Invisible raising screw for music-stools, and other articles of furniture.
1150	Griffiths and Hopkins	Birmingham	Roasting, baking, and warming apparatus.
1151	Phillip Henry Broadhurst and John Wood, jun.	Sheffield, manufacturers	Shoe sad iron.

CONTENTS OF THIS NUMBE

LONDON: Edited, Printed, and Publis Joseph Clinton Robertson, of No. 16 street, in the City of London.—Sold b W. Galignani, Rue Vivienne, Paris; Ma Co., Dublin; W. C. Campbell and Co., Ha

Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 1252.] SATURDAY, AUGUST 7. [Price 3*d*.

Edited by J. C. Robertson, 166 Fleet-street.

CRADDOCK'S HIGH-PRESSURE, EXPANSION, AND CONDENSING STEAM-ENGINE.

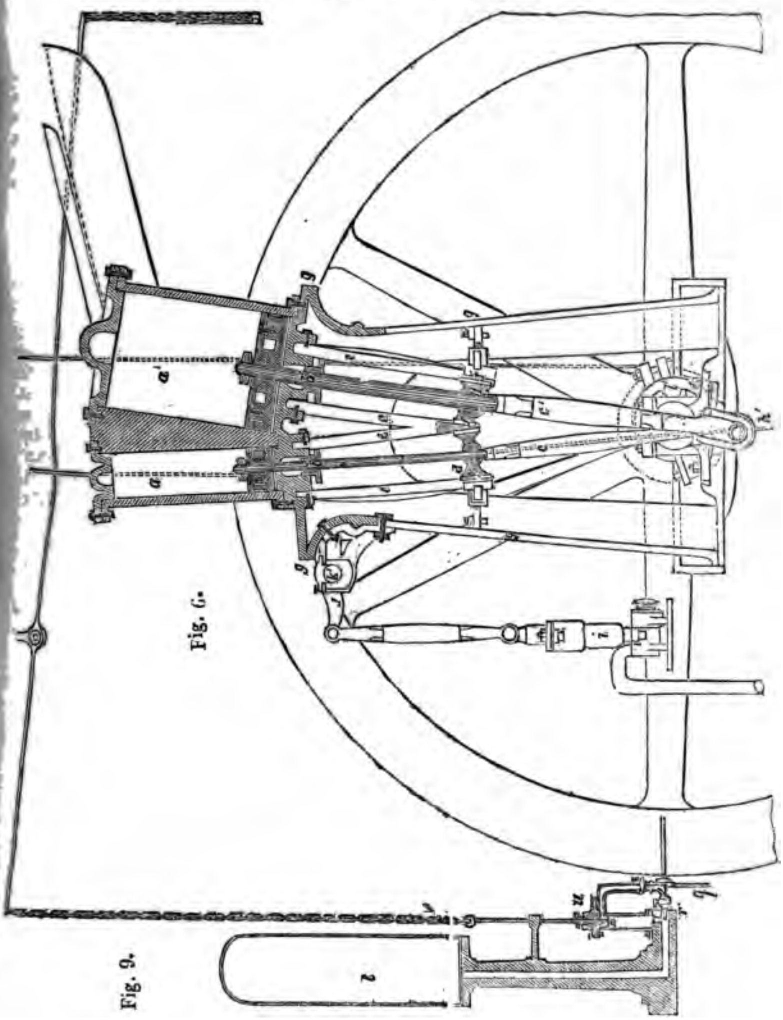


Fig. 6.

Fig. 9.

CRADDOCK'S HIGH-PRESSURE, EXPANSION, AND CONDENSING STEAM-EN

[Patent dated December 3rd, 1846. Specification enrolled June 3rd, 1847.]

We now proceed, in continuation of the article in our last number, to extract from Mr. Craddock's specification an account of his high-pressure, expansion, and condensing engine, which, besides embodying his improved system of condensation (describedin our last number), presents the following striking peculiarities:

1st. A new mode of obtaining direct action, by inclining the engines at an angle towards each other, instead of placing them in parallel positions.

2nd. A boiler with vertical water-tubes.

3rd. A self-acting damper, which ensures an uniform emission of steam.

4th. A new arrangement of the steam-chest, whereby the evil of priming is obviated.

5th. An improved air-pump.

6th. Improved slide-valves. And,

7th. A combination in the same engine of more or less of the advantages peculiar to each of the three systems—high-pressure, expansion, and condensation.

In judging, however, of the advantages arising from the triple combination referred to under the 7th head, we must again caution the reader to keep in mind that the inventor insists upon them only where water is scarce, or not conveniently obtainable, as on railways.

Mr. Craddock quotes from (*Chemistry of the Steam Engine*) a Report made by Mr. Cowper, a foreman in the Smethwick establishment of Messrs. Fox, Henderson, and Co., the following account of the results obtained from the *first* engine ever constructed on the plan about to be described. It was an engine with two cylinders, one small and one large (on the well-known plan of Hornblower); the area of the small or high-pressure was 38·5 square ins.—velocity of the piston, 146 feet per minute—average effective pressure, 77·82 lbs. per in.; the area of the large or expanding cylinder, 156 ins.—velocity of piston, 220—pressure, 10·16 lbs. The following is Mr. Cowper's report:

"I have to report the following in reference to 'Craddock's Universal Condensing Engine:'—The condenser is
many months' work, quite as p
air-tight as it was when first start
is no appearance of wear or deter
any kind having taken place, ex
course, the stop brass, which is
worn. The condenser has contin
a very steady vacuum of 22 or 2
mercury, according to the work p
the state of the weather, which
generally affect the vacuum more t
one inch of mercury. The con
quires about one and a half horse
the engine to drive it; but it enab
obtain a much larger amount of
consequence of the vacuum obta
the means it thus gives of using m
sion than would otherwise be pos
a high-pressure engine, supposing
be scarce or expensive. The boi
doubt, very safe, as, even in case
giving way, no serious danger wo
to any person. But the circum
there being so small a quantity
contained in the boiler, necessarily
a greater irregularity in the press
steam, supposing the fire to vary s
The self-acting damper is a very
contrivance, and answers its pur
well; it is applicable to any boiler
high or low pressure, and is a gre
keeping the pressure of the steam
the boiler.

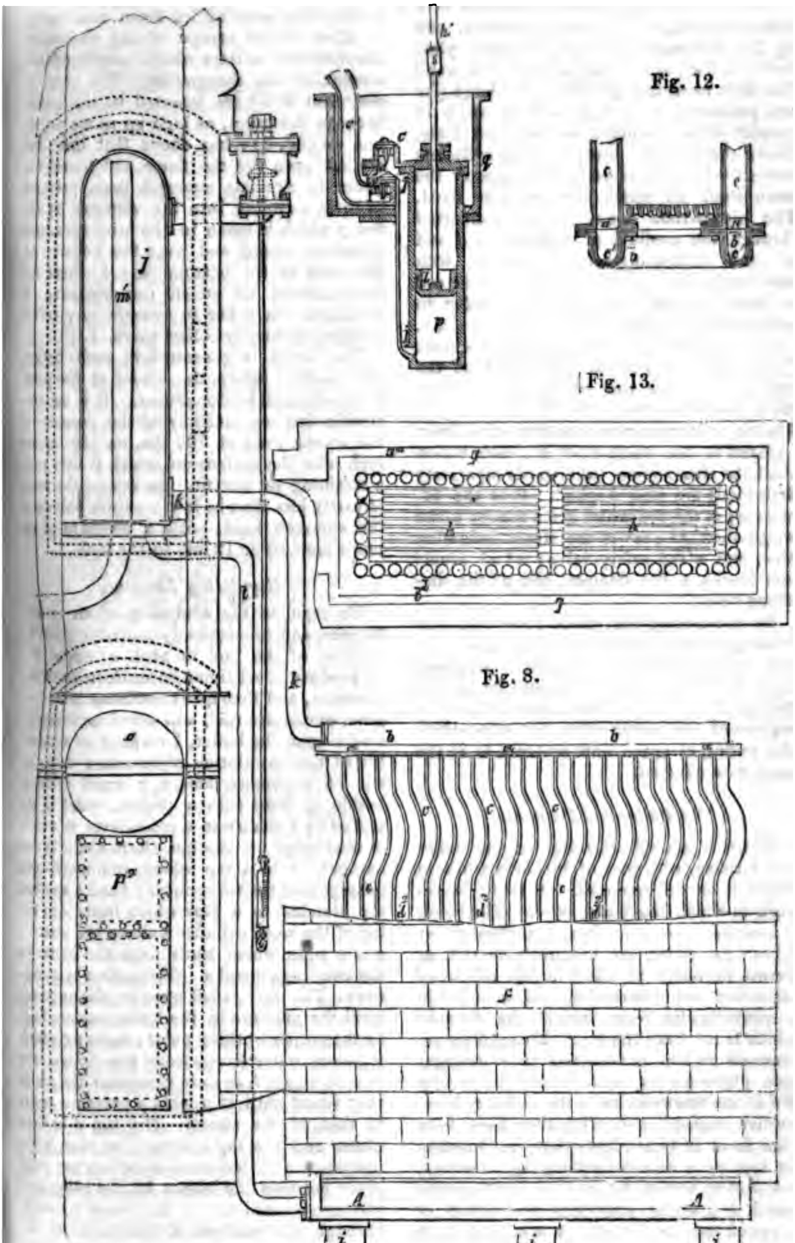
"The indicator figures I have
the engine, show that a vacuum
per square inch is fully realized in
cylinder, supposing steam of abo
pressure per square inch to be us
small cylinder of the engine."

Mr. Craddock admits this repo
"perfectly fair and candid," but
the same time such allowances f
performance as no person of com
dour will be indisposed to concede.

"It must be borne in mind that t
was the first attempt at a thing of t
and was constructed, as I have said
continued practical use, but merel
the principles; yet the boiler is still
and confirming, beyond a questi
soundness of the principles embodi
All that is required to make it as
as little liable to derangement, ar
more free from danger than the us
nish boiler, is a little more experien
construction, with a better proporti
it to its purpose; nor would it be r
pensive than the Cornish boiler for
duction of the same power."

We now proceed to our extracts f
specification:—

Figs. 10. Fig. 11. Fig. 12. Fig. 13. Fig. 8.



The Engines.

Figure 6 is a longitudinal elevation of a stationary engine of this description, and fig. 7 a transverse elevation. The two cylinders *a* and a^1, which are, as usual, one small (for high pressure) and the other large (for low pressure), are set at such an angle in respect of one another, as that two lines, drawn through the centres of the cylinders respectively, shall meet in the centre of the main shaft on which the crank is fixed. The piston-rods *b* and b^1 are connected through the medium of cross-heads *d* and d^1, and connecting-rods *c* and c^1, with one crank-pin c^2, the lower end of the rod c^1 being forked (see fig. 7) in order to admit within it the end of the other rod *c*. *e e e e* are guides on which the guide brasses *f f f f* slide. *g g* is the framework of the engine. h^1 is a rod which gives motion from the cross-head *d* to the air-pump *p*. *i* is the boiler pump worked through a lever *j* affixed to the weigh-shaft k^1, from which shaft the steam valves (afterwards separately described) are also worked. l^1 is the eccentric; *m* the rod which gives motion to the weigh-shaft k^1; m^1 is the steam induction pipe, and *n* the safety-valve; n^1 n^1 plummer blocks, *o* the damper, and p^2 the distilling vessel.

By connecting the piston-rods with one crank-pin, in the manner which has been just described, a direct action is obtained from the two cylinders in a more favourable manner than has yet been accomplished in engines of this description, and a considerable saving of space and material is at the same time effected.

The Boiler and Furnace.

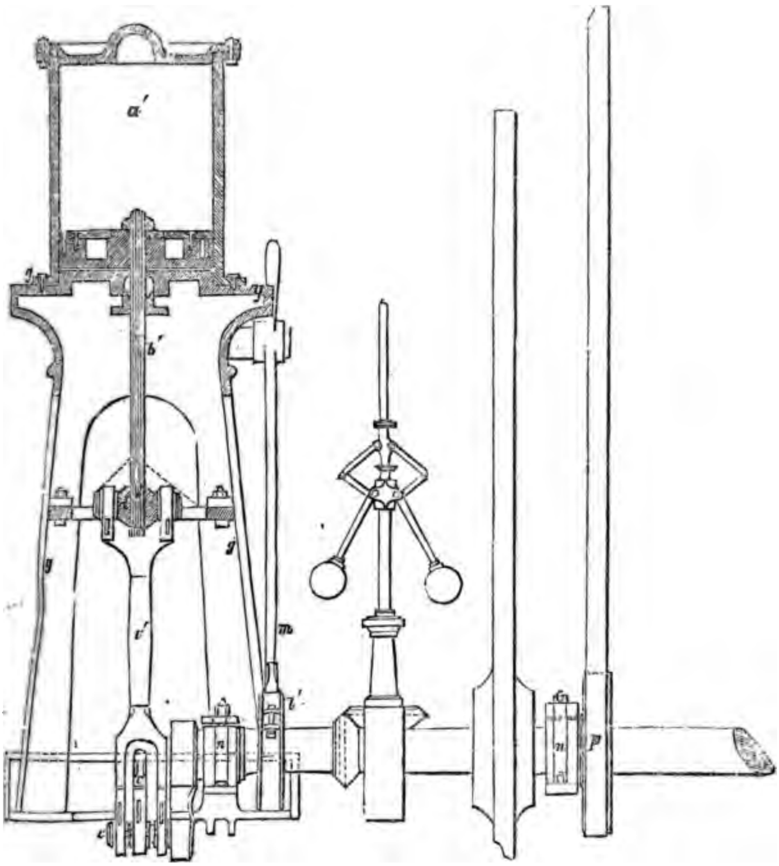
Figure 8 is a side-elevation of the boiler and furnace, with part of the brickwork in which it is set removed. A is the brickwork in which the boiler is set. The boiler is composed of a number of vertical water tubes *c c c*, which are uniformly curved, as shown, in order to allow for the effects of expansion and contraction, and arranged in a quadrangular form round the furnace which is fed from the top. These tubes are inserted at top and bottom into wrought iron plates *a a a a*, and secured by ferules *d d* in the same way as in the ordinary locomotive engine; and after they have been thus fixed in their places they are closed in at top by a hollow rectangular chamber, *b b*, and at bottom by another single chamber b^1 b^1, which chambers are bolted or screwed on to the plates *a a*, and have curved channels c^1 c^1 running along their edges, so that there may be a free intercommunication between the whole series of pipes both longitudinally and transversely. The fire-grating *h h* is made in tw which turn on hinges at their ou so that they may be let down occ to allow of the escape of any cli unconsumed matters which may h accumulate on the grating. The cast iron d^2 d^2 are inserted in th between the tubes, as high up as th line *e e* (fig. 8); but above that l are left open for the flame and h pours to circulate amongst them to their escaping into the chimne flue *g* which is made in the brickw passes all round and over the boi the ends of the bottom case b^1 t caps screwed on which can be t at pleasure in order to remove an matters which may collect there.

The steam is generated in such with perfect safety, the whole of being of small sectional area. It is strable that on multiplying the pr the steam, even at 100 lbs. on th inch into the surface on which it a straining or bursting tendency, is vastly less than in low pressure l the common kind, with a pressu more than 10 or 12 lbs. to the inch

Regulating Damper,

To regulate the admission of ai furnace, and consequently controul bustion of the fuel in such a m to produce at all times an uniform of steam, and thus give steadiness t gine, economise fuel, and avoid unr strain upon the boiler, I employ an tus of the description represented *t* is an air-vessel, and *u* a small beside it fitted with a piston, whi tached by a chain *v* to a cross-lever is connected by another short cha damper: *r* is a tap which comm passage into the air cylinder; *t* and *s* tap attached to a pipe which leads top of the small cylinder *u* above the *q* is a pipe which leads from the the two taps *r* and *s*. The action lows: The tap *r* is left open by the until the pressure in the boiler has to the proper working point; in doi it forces water (cold) from the bo the air-vessel *t*, so as to compress t that vessel until it attains a pressu to that of the steam. The tap closed and the tap *s* opened, so th matters are in that state no action place between the steam in the b the compressed air in the vessel through the medium of the pisto small cylinder *u*. As soon, ther any slight increase of pressure in t arises it produces a correspondin sion of the piston in *u*, which pu

Fig. 7.



the chain *v* and lever *w*, and thereby closes the damper, which lowers the pressure of the steam in the boiler to the working standard; and when that takes place the preponderating pressure of the compressed air in the vessel *t* forces the piston of *u* up again, and therewith the chain *v* and lever *w*, which opens the damper. The water introduced to the cylinder *u* being cold allows of a leather piston being used, the friction attending which is small and uniform.

The Steam Chest.

The steam chest is placed within the chimney and is of small transverse diameter, but lengthened in one direction. The steam enters through the pipe *k*, and is conveyed thence to the engine by a pipe *m*, the mouth of which is carried to near the top of the chest, so that any water which may come along with the steam may fall by its own gravity down to the bottom of the chest, from which it is returned by a pipe *l* into the boilers. The evil effects of priming, which have been hitherto a great drawback from the advantages of all tubular boilers, are thus completely obviated.

(*To be continued.*)

CURSORY OBSERVATIONS ON MICROSOPIC PHILOSOPHIZING, PARTICULARLY IN REFERENCE TO THE PHYSIOLOGICAL PAPERS PUBLISHED IN THE TRANSACTIONS OF THE ROYAL SOCIETY.

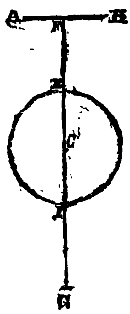
If a person were to examine an object placed at a proper distance for observation, and another person, having the same distinctness of vision, were to view it at a much greater distance, and a third person, having the same powers of eyesight, were to examine it through a microscope, and were each person to describe the object according to the impression which it had conveyed, their descriptions would all differ amongst themselves; and were they each to give their descriptions of the object, without stating the circumstances under which they had viewed and examined it, their descriptions would obviously form matter for dispute, not only among readers generally, but also amongst themselves.

Bishop Berkeley says, "Take an inch marked on a ruler, view it successively at the distance of half a foot, a foot, a foot and half from the eye; at each of which, and at all the intermediate distances, there shall be more or fewer points discerned in it. Now I ask, which of all these various extensions is that stated determinate one that is agreed on for a common measure of the other magnitudes?" In this instance, if the inch were viewed at the several distances by different persons having the same clearness of vision, its number of points would appear different to each observer, and were they each to describe the inch as it had appeared, it is quite clear that their descriptions would not agree; very probably each observer would maintain that the others were wrong, and that he alone was right.

What has been said, perhaps, renders it pretty manifest that before the observers can agree in their descriptions of an object viewed, they must be brought acquainted with the particular circumstances under which it has been respectively examined, and must modify their descriptions accordingly.

The simple theory of microscopes may be thus briefly explained. If an object be placed in the focus of a convex lens, and the eye be at a proper distance for vision on the other side, the object will appear distinct and erect, and it will be magnified in the ratio of the focal distance of the lens to the common distance of distinct vision, that is, about eight inches, or,—

Thus, suppose an object AB to be placed in the focus F of a small glass sphere, and the eye behind it in the focus G; the object will appear distinct and in an erect position, and it will moreover be increased in magnitude in the ratio of $\frac{3}{4}$ths of EI to eight inches. Let the diameter $EI = \frac{1}{10}$th of an inch, then $CE = \frac{1}{20}$, and $EF = \frac{1}{2} CE = \frac{1}{40}$, hence $CF = \frac{8}{40}$.



$\therefore \frac{3}{40} : 3 ::$ the natural size : the magnified appearance,

or $3 : 320 :: 1 : 106\frac{2}{3}$,

that is, the object is magnified nearly 107 times. This explanation applies to single microscopes; but it will be obvious from this simple example that a trifling difference in the power of the lens will very considerably increase or diminish the magnified appearance. The same remark applies, taking their complex construction into account, to the various kinds of compound microscopes which are generally used in philosophical inquiries.

A globular object, which is less than $\frac{1}{680}$th of an inch in diameter, is to most eyes totally invisible. An object which is $\frac{1}{480}$th of an inch in diameter subtends an angle of one minute at the distance of eight inches from the eye. No object, therefore, less than $\frac{1}{480}$th of an inch in diameter can be seen by *common eyes*. (*Encyc. Metrop. Optics*, 425.)

To the generality of eyes, the nearest distance of distinct vision is, as before observed about eight inches, called the minimum visible. Some eyes, however, can see small objects best at the distance of 6, 4, or even 3 inches; whilst others can see most distinctly at 12 or 15 inches.

Now supposing the above sphere to be used by each of these persons, then

$$\left.\begin{array}{l} \frac{1}{40} : 6 :: 1 : 80 \\ \frac{1}{40} : 4 :: 1 : 53\frac{1}{3} \\ \frac{1}{40} : 3 :: 1 : 40 \\ \frac{1}{40} : 12 :: 1 : 160 \\ \frac{1}{40} : 15 :: 1 : 200 \end{array}\right\}\text{the magnified appearance of the object.}$$

From these very simple illustrations it will be obvious that a small object viewed by the same person through different microscopes will not appear to be the same; also, that if the same small object be viewed through the same microscope by two persons having eyes possessing different powers of distinct vision it will not appear alike to each observer. Hence if each observer describe the object as it appeared to him, their descriptions will manifestly differ. If the microscopes they employ be precisely of the same construction, and their eyes be exactly of the same formation, very probably their descriptions of the object viewed would agree: on the other hand, if their eyes are alike, and their microscopes differ, or if their microscopes be the same, and their eyes not alike, some modification must take place so that they may each view the object under the same circumstances, before their descriptions of it can possibly concur.

It requires no formal demonstration to prove that if either of the observers were to generalize upon his observations without any explanation respecting eye-sight, instruments, &c., a theory resting upon such a basis would be altogether nugatory. If, for instance, any substance has been examined, and alleged to be composed of particles of a certain form or kind, unless upon a proper examination it be found to be so made up, the allegation relative to its component parts is a matter of doubt or denial: hence such examinations, however scientifically and carefully made, can add little or nothing to our real knowledge of the constituent parts of bodies, unless the observers also minutely detail the process by which they were examined, and all the circumstances with regard to instruments, vision, &c., connected with the investigations; so that if the objects be viewed by other observers, with the same care and under the same incidents, they may appear to all alike. Unless this concurrence be general, any peculiarity must be attributed to eye-sight, instrument, &c. The same body similarly scrutinized must always appear the same; and it would be idle to assert that observers, who differ as to the form of the component particles of bodies, by such differences at all increase our knowledge of the real intrinsic nature of such bodies; their disputes are difficult to reconcile; they tend to impede rather than to accelerate science.

It is no easy matter to account satisfactorily for the striking discrepancies which occur in the descriptions of the constituent particles of matter, even when the authors of such descriptions are men alike accustomed to such examinations, and whose acuteness, probity, and talents are equally undoubted, unless these differences can be referred to some dissimilarity in the instruments employed, or to some unlikeness in the observers' powers of vision. But however honest and careful each observer may be, it is evident that their differences render their labours very nearly abortive. They do not advance knowledge. It is much easier to jump to the conclusion that they are all wrong than it is to ascertain which is right; especially if the groundwork of their descriptions be not fully and carefully explained.

My talented neighbour, Dr. Shapter, in his interesting address to the Medical Association, held at Leeds not long ago, relates a remarkable instance of this diversity of description:

Dr. Martin Barry had minutely investigated the blood corpuscles, and the conclusion drawn from his elaborate investigation was, that the red corpuscle is a primary nucleated cell, circular in form, flattened on its surface, and rounded at its edges, having a diameter ranging from about $\frac{1}{3500}$ of an inch to $\frac{1}{4000}$ of an inch.

Mr. Wharton Jones, in a paper read before the Royal Society, December 8, 1842, mainly with the view of combating some of the statements of Dr. Martin Barry, says, that the red corpuscle consists of a vesicle or cell with thick walls, but in a collapsed and flattened state, and having therefore a bi-concave

form, and, in consequence of its thick wall being doubled on itself, presenting under a microscope a broad circumferential ring, which is illumined or shaded differently from the depressed central portion according to the focal adjustment of the instrument.

The account of Mr. Addison, though in some respects similar to that of Mr. Jones, differs entirely as to the origin of the diversities of shade in the ring and centre of the corpuscle: he concludes that these appearances are due to the fact of the corpuscle consisting of two elastic vesicles, one within the other: Mr. Addison states the average size of these corpuscles to be $\frac{1}{3800}$ of an inch in diameter.

The reader may learn from Dr. Shapter's condensed summary on this subject, that Dr. Barry, Mr. Wharton Jones, Mr. Addison, Dr. Willshire, and Dr. Carpenter, all differ in some respects among themselves with regard to the form and component parts of the red corpuscle. When doctors so disagree it certainly is difficult to decide.

Undoubtedly Dr. Barry, Mr. Wharton Jones, and the other gentlemen mentioned, were alike solicitous to describe the object exactly as it appeared; each was equally anxious to advance science upon the basis of truth: how, then, may their very contradictory conclusions be reconciled? They cannot be all correct; but how may the origin of their various differences be discovered? In the absence of all information upon the mystery—it does appear to be extremely likely that they did not start fair; or, in other words, that they did not all view the objects which they describe, and about the appearance of which they so strangely differ, through the same microscope, or with the same power of eyesight; that is, that they did not examine the object under exactly similar circumstances. Taking the extreme minuteness of the object into consideration, very probably a small variation in the glass or eye is sufficient to explain many of the differences between the doctors. Such variation would evidently affect the appearance of the *thick walls* or *circles* of the corpuscle; for the reader must bear in mind that the red corpuscle, whether made of THICK WALLS or CIRCLES is about TEN times less than the smallest object that can be seen by th common eye.

Mr. Coddrington, in his *Trea Optical Instruments*, mentions the glass of a microscope made by Mr. which shows with great distinctnes part of a large field of fine striæ scales of a moth's wing, which discerned at all with large micr of the ordinary construction made best opticians.

It is pretty clear, that an o using this microscope, and another competent observer making use other microscope, would differ i descriptions of a moth's wing: on assert that it had fine striæ, th would maintain that it had nothin kind on it. Which observer wou the fact? Does the moth's wing exhibit striæ, or is there any pec in the object glass which gives pearance? Do microscopes alwa things really in being, or do the times treat us with appearances v optical illusions! The oxyhydro croscope makes the animalcule drop of liquid appear of enormo it is said that a countryman onc ing at them wished to be off le should come out. Here no doubt ing was believing," but the ast observer did not think of the at of such monsters being enabled bol in a drop of liquid.

Whether the fact quoted fro Coddrington's book, or the remar it, will suggest any explanation of ferences among the doctors, is a q which must remain unanswered: th ma cannot easily be solved. The themselves should so far agree as about tracing their disputes to th cause. One fact is certain, the differences do not advance genera ledge even among the members o own profession. Doctor Shapte lication before referred to was for the purpose of placing bef Association the exact state of science; with this view, having stated the opinion of each theor respect to the red corpuscle, the very justly says, "between th flicting testimony it is difficult to and the matter must be left for investigation." Instead, therefore ing before the Association staten settled and useful facts upon the the doctor, with all his care and re could only serve them with a st

tions. Now, if the red corpuscle
od be made up of certain com-
arts of definite form, those parts
s must appear alike to all com-
servers, if examined under the
cumstances with regard to in-
and eyes. It is absurd to say
stituent parts are understood, if
not so invariably appear the
Dr. Shapter's conclusion proves
conflicting opinions of the doc-
er their labours almost useless:
a scientific or a professional
view, their differences establish
but they excite doubts, not as to
right, but whether they are not
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and another equally learned set
," and they leave it quite un-
whether the ayes or the noes
or whether either ought to have
obviously no knowledge worth
an be based upon such a doubt-
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powers on such dubious specu-
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on, has taken the opposite side
gument, whether to gain a prize
celebrity, does not appear; but,
ents, he manfully combats Dr.
statements, and makes it very
which is correct, or whether
y not be wrong. Now, the
hical Transactions being a na-
rk of the highest repute, every
Englishman would see them if
. There are lovers of science
y be fairly termed countryfied philosophers—men whose love for science is great, but whose pecuniary means are small. Many such men, by carefully husbanding their incomes, contrive to purchase the *Transactions* as a mental treat. Of course they read the *whole*—they cannot afford to miss anything; and they naturally infer that all they find therein is of the first water. The very laborious physiological essays referred to have filled a large part of many numbers. No doubt they are particularly interesting to professional readers; but to the sort of readers above mentioned, it requires a mind well made up to get through them. However great the thirst for knowledge may be, to many non-professional readers the wading through such masses of blood-corpuscles, arteries, &c., &c., is very like taking physic when one had rather not. But a reader of the description named, having gone through the task of reading those articles, and having, as he thought, added to his knowledge the fact that red corpuscles are of a certain formation, how very much annoyed he must feel in perusing a similar article in the next number to find, in strong terms, that his fancied acquisition of knowledge is all moonshine,—that blood corpuscles are not of the form first fixed on his mind, but of some other, or of no form at all! Is it not to be regretted that readers of this class should be entrapped by the repute of the publication thus to throw away their time and money? Had they been tempted to meddle with the lumber parts of physical publication, they would have no right to complain; but, unquestionbly, the rulers of British science should have some regard for readers who buy books to read, and not merely to fill shelves. The writer has a strong fellow-feeling with this kind of readers; and he can speak positively as to the effect which such contradictory theories have on their minds: on this account, therefore, he trusts that the preceding strictures are pardonable. The suppositions, as to how those learned gentlemen may have arrived at their very opposite conclusions, are mere conjectures, and nothing more; but if they are not satisfactory to writers who philosophize upon bare seeing, they will perhaps feel the propriety of solving the puzzle themselves. If they do this, the writer's object will be accomplished. No attempt

to theorise has been made: the writer in some of his suppositions may be right, but that is a matter of indifference. It may be easy to show that many of his hypotheses are founded in error or misconception; but this also is of no importance. His aim is not that any one should take the trouble to prove his notions right or wrong, but to call attention to conflicting theories, the publication of which he thinks he has shown to be useless even to professional readers—and, certainly, they are of no kind of service to any one besides. It would ill become the writer, and be directly against his wishes, to speak lightly of the promoters of science: some of the learned doctors already named are justly celebrated for their scientific achievements. He trusts that they will continue their praiseworthy exertions; but at the same time he wishes to express a decided opinion that conjectural hypotheses on subjects entirely professional, however elaborate, would be more appropriate in publications altogether devoted to such discussions, than they are in works adapted and intended for general readers.

The question may be fairly asked, "Why should one of the learned professions be allowed to fill so large a part of the *Philosophical Transactions* with lucubrations which are altogether professional, whilst the labours of the other two professions, as they are termed, are excluded?" Would not a laborious essay on contingent remainders, or a very learned article occasionally on the notions of the ancient fathers, be just as philosophical, and quite as instructive, as such huge masses of discordant physiological matter? At all events, it would introduce variety. It seems unfair for physic to engross too much space to the entire exclusion of law and divinity. However, if the doctors will not concur in the fairness of this opinion, as a body they have the power to decide and act accordingly. The "M. Ds." form a very formidable phalanx in the Royal Society—those Roman numerals appear to have a strong, perhaps a natural kind of, affinity to stand before F.R.S. On this topic, Mr. Babbage, *Decline of Science*, page 187, says: "The honour of belonging to the Royal Society is much sought after by medical men, as contributing to the success of their professional efforts, and two consequences result fr In the first place, the pages *Transactions of the Royal Soci* easionally contain medical papers moderate merit: and, in the seco preponderance of the medical i introduces into the Society some jealousies of that profession. other hand, medicine is intimatel nected with many sciences, and i fessors are usually too much occu their practice to exert themselves, upon great occasions." No rem made on these strictures; but it easy matter to count heads in the Society's list of Fellows, and to pages in its published *Transactio*

In the case that has been discus doctors only agree to dispute; he it is hoped, they will *start fair*.

What microscopic philosophize or pretend to see, are realities or i ary objects; they describe facts o cies. If they write about real a same entities, their descriptions o ought to be alike; and when they strong doubts must arise as to whi lineation is correct: and the read is incompetent to repeat the ne experiments to get at a decided and who does not know enough of of the disputants to pin his fa what he asserts, naturally conclud the whole is too imaginary to any service, or to establish an Such labours, wherever or howeve lished, if they were properly cla must come under the denominat exceedingly useless philosophizin very learned trifling—well adapt disappoint the *countryfied philos* and fit only to increase the bull publication, without in the smalle gree adding to its credit or value.

In reference to the preceding ar has been observed to the writer, ' general and extensive is the *agr* of observers as to the form, &c., jects known only through the micro and what a vast amount of philoso scepticism we must admit, if we rej that is visible to the eye when a by a lens."

It has also been remarked, "Th papers in the *Philosophical Tr tions*, to which allusion has been ought not to be considered as p sional; they are papers of sci

gical) investigation, and me- such subjects have always been into the *Philosophical Trans-* and into those of other scientific ,

observations do not exactly meet t of the paper which they are to controvert. The *agreement* ers has raised no question;— AGREEMENT in their descrip- the *same object*, especially in *osophical Transactions*, was mooted. What is the reason differences is one of the topics , and which microscopic theo- invited to explain. It is quite we must admit a large amount ophical scepticism "*if*" we re- hat is made visible by a lens; has advocated such rejection? object made visible by a lens, med, ought to appear alike to all , and their descriptions of it agree: if not, why not?
anner of doubt was intended to as to whether such memoirs admitted into the *Philosophi- sactions* and other publications, stress has undoubtedly been heir utility. If they are not ial articles, under what cate- at they to be placed? If the to which they particularly re- extract nothing satisfactory from ow can they possibly promote r practically extend knowledge? ey effect neither the one object ther,—the question, *Cui bono?* ur, no matter how celebrated cation that burthens itself with ginary dissertations.

---

he preceding paper was written, l Society's singular bestowal of medals on Dr. Beck's physio- ticle, has occasioned much dis- According to the Society's own of that memorable proceeding, rs not only manage matters of pretty much in their own way, set the laws and regulations of ety altogether at defiance, in rown the unpublished lucubra- one of their professional com- h a medal.
ting the published statements of he members of the Society, who the special meeting on the 11th ry last, to be correct, the conferring a medal on Dr. Beck was not only irregular and illegal, but thoroughly disreputable. For members of a Society, which assumes to stand at the head of English science, to confer its highest reward by a species of jockeyship, is a national disgrace. It is to be hoped that the Society, for its own credit, will prevent the recurrence of such an act, and hereafter severely punish any of its members who may have the temerity to attempt it.

Committees of members of the Royal Society, it seems, are appointed in each department of science. The occasional exercise of their functions, whatever these functions may be, can be guessed from what has been published in reference to Dr. Beck's medal. It is said the Committees determine what papers shall be printed in the *Transactions*. Whether the same kind of justice is exercised in selecting articles for publication as there is in shuffling for medals, is a question that cannot be readily answered—it is hoped not.

Might not the services of the Committees be rendered of some real value if, when essays on the same subject lead to directly opposite results, or flatly contradict each other, the members were cursorily to examine the principles of these essays, and call upon their authors for explanation, if any were wanted, so as to be able to add some elucidation of their own, showing briefly in what respects, and on what grounds, the speculators differ? Such an examination and commentary would not only be signally advantageous to readers generally, but their influence would extend even to the writers of the *Transactions*. "What author, indeed, but will write his best when he knows that his work, if it have merit, will immediately be reported on by a Committee who will enter into all its meaning, understand it, however profound, and, not content with *merely* understanding it, pursue the trains of thought to which it leads, place its discoveries and principles in new and unexpected lights, and bring the whole of their knowledge of collateral subjects to bear upon it."—(*Herschel on Sound, Encyclo. Metropol.*) Be this, however, as it may, clearly the filling large books with articles that are very like professional papers, quite contradicting each other, without one word of explanation,

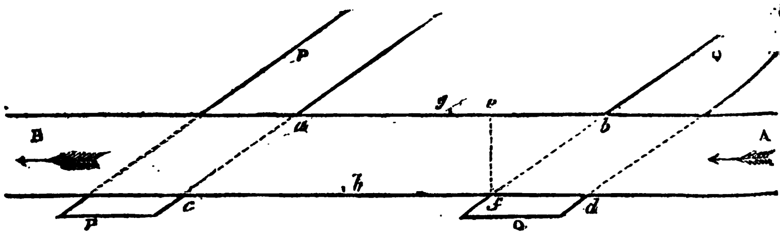
does not entitle the managers of such publications to the purchaser's thanks, nor does it afford very convincing proof of the Committee's usefulness.

Sir John Herschel, Mr. Babbage, and others have complained that science in England does not keep pace with the science of other countries. Supposing the complaint to be well founded, the question readily occurs, has the Royal Society done its duty to the nation by impartially encouraging the votaries of science? Does it at present, it may be asked, becomingly favour the cultivators of science, without distinction as to clique or clan? If it do not, can its rules and regulations be so modified as to become of national importance, and adequate to the absolute requirements of the age? If it be not thus adapted, and cannot be rendered so, must it not hereafter be considered a venerable piece of antiquity, which has worn out all its utility, and, in fact, become a sad nuisance, by filling up the position that an institution nationally useful ought to occupy? However, report states that improved rules and regulations will shortly be introduced into the Royal Society: it is hoped the rumour will prove to be correct. The Society is a national one: recent occurrences must have convinced every friend to British science that there is room for improvement in the general management of that body corporate; and he must feel solicitous that the Society should at once earnestly set about modifying its regulations, so as completely to remove all cause of *suspicion* or complaint. Some supervision and explanation of the kind above mentioned is strongly recommended to those members of the Society, who wish its labours to be as nationally beneficial as they ought to be high in celebrity.

J. J.

Exeter, July 12, 1847.

SKEW PIERS AND IRON GIRDERS.



Now that the attention of the scientific world is so much drawn to the fall of the railway bridge at Chester, every consideration connected with the subject becomes interesting.

It is a skew bridge with three openings of 98 feet each. It was proved before the Coroner by witnesses who observed the fall, that when a heavy engine passed over the bridge, the girders deflected to the extent of 5 inches in the centre.

In the above plan, *a b* and *c d* represent a pair of girders supported by the oblique piers P P and Q Q. As an engine passes from A to B, when it gets to *e f* one side rests on the pier Q, while the other, at *e*, is on the girder *a b*, which has begun to deflect with its weight; and until it reaches *g* the centre of the opening *a b*, the wheel on *a b* will be lower than the wheel on *c d*. Having passed the centre of *a b*, the wheel on *a b* begins to rise, while that on *c d* continues to sink till it reaches *h*, the centre of *c d*; and from thence to the pier P, the wheel on *a b* will be the highest. If, as at Chester, there be a second and a third opening, the same process of the sides being alternately raised and depressed will follow at equal intervals. It is difficult to know exactly what is the period of oscillation of a locomotive engine, but

eel in passing from its lowest
est point coincide with the time
by each, it could not fail to
eat effect in increasing alter-
pressure on the two girders.
cture at Chester occurred in
of the third girder; that is, at
where for the third time in
ccession the engine was at the
oint of its oscillation towards
hat broke. It would be too
say that this occasioned the
but it may have been among
vating causes that led to it;
well worth considering, with
to the application of girders to
ges of *many openings*.
travelling at 30 miles an hour
seconds to pass over 100 feet.
t speak as to the time in which
of a given construction would
but if the law governing the
of bodies above the point of
e the same that exists as to
s, an engine having its centre
ion 39 inches above the rail
rate in one second; and conse-
oscillations would tally exactly
swingings occasioned by the
and risings of the girder when
at 30 miles an hour. Should
of oscillation be, as it pro-
considerably more than 39
ove the rail, the same effect
produced when the rate of tra-
s less than 30 miles an hour.

P.

uly 22, 1847.

E'S BALANCE BRACKET GIRDER.

n the "Investigation of the
of Cast Iron Beams, or Gir-
loyed in the Construction of
which you have done me the
inserting in the last number of
al, I endeavoured to demon-
advantages of causing the gir-
ensile-beam, to act in unison.
now permit me to add that it
a special view to a union of
ntages that my father designed
ce bracket girder, described
eding number (1251) of your

vantages proposed for this form
re: 1st., That by tapering from
ent, and making the fulcrum
ead of, as is usually the case,
at the centre of the girder, a great deal of material is discharged from the structure, which would otherwise act with an effective leverage, proportional to the length of the beam, to the production of a great deal of strain at the centre, tending to facilitate the destruction of the bridge. Thus, if P_2 = the weight of material discharged by this form of girder, and p = the distance of the centre of gravity of the material and the abutment; then P_2p = the effect which the material discharged would have in producing fracture; and consequently by getting rid of the material the bridge will be strengthened to this extent.

2nd. The material of the bridge is economized to the extent of the quantity taken away. Or, which is perhaps better, by placing the material taken from the centre of the girder in the bracketed form, the strength of the bridge is vastly increased.

3rd. By reason of the form of girder, and of the fulcrum being immediately over the fixed abutments, the lateral action from the compressive force is prevented,* and the action of a train in passing over would not be so likely to produce that motion which is so liable to derange the construction.

4th. That by reason of the tensile bars acting at some distance below the points to which the ears are attached to the girder, sufficient latitude is allowed for the difference of action in wrought and cast iron, under pressure. Whilst the tensile rods being carried back by means of short horizontal bars, the whole of the force is taken away from the upper edge of the beam.

The equations and calculation of the balance bracket girder are made similar to those in the paper published in your last number; but as I think the subject worth further consideration, I may be tempted, in some subsequent number of

* In the "Investigation" it is stated that the tensile flange should be much larger or broader than the compression flange, and that experiments have proved the difference to be in the proportion of 6:1. It would, however, be dangerous in practice to adopt the extreme of this theory, especially in bridges of long dimensions, from the fact of a compression line under pressure being so liable to become crooked, and thus lose its strength from lateral deviation. More material must, therefore, be placed in the compression flange, than is absolutely necessary to resist the compression, or to stiffen that part of the beam, and prevent lateral deviation.

your journal, to trouble you with a mathematical investigation of it.

I am, Sir, yours, &c.,
W. Dredge, C. E.

HORÆ ALGEBRAICÆ. BY JAMES COCKLE, ESQ., M. A., BARRISTER-AT-LAW.

(Continued from page 15.)

II. UNLIMITED PROBLEMS—THE EXERCISE—SELECTION OF RESULTS.

The following two equations,—

$$5x+7y=29 \ldots\ldots\ldots\ldots (1)$$
$$9x+15y=2 \ldots\ldots\ldots\ldots (2)$$

completely determine x and y; and these quantities admit of no other values than those given below (*a*). But if we had only *one* of the above equations proposed for solution,—the equation (1) for instance,—all that we could do (without introducing other conditions) would be to determine x in terms of y, or *vice versâ*. We may however introduce any other condition that we please provided only that it be not inconsistent with (1). Thus we may make (2) the second condition; or we may give to x any values that we please, and so arrive at corresponding values of y, or *vice versâ*. In fact, since we may vary as we please the second condition, we may obtain an infinite number of solutions of (1); and, considered with reference to that number, this species of problem may properly be termed an *infinite*, or *unlimited*, problem. Again since the equation (1) would, of itself, only enable us to find one of the quantities (x and y) in terms of the other, one of those quantities will remain undertermined; and, hence, we may apply to this kind of question the term *undetermined* or *indeterminate*. The latter is the term in use.

But a problem is often called "indeterminate" which is not so in the above sense of the word. Thus;—to the equation,

$$5x+7y=29 \ldots\ldots\ldots\ldots (1)$$

let there be attached the condition

x and y are positive integers.. (3)

then $x=3$ and $y=2$ are the only (*b*) values of x and y which satisfy (1) and (3) simultaneously. Hence the problem is as *determinate* as when we [...] satisfy (1) and (2) simultaneously. [...] yet, the second condition (3) not b[...] the present case given in the form [...] equation between x and y, the pro[...] called an "indeterminate" one[...] that that term seems rather to have [...] ence to the form of the second co[...] than to the real nature of the q[...] as defined by the two conditions ([...] (3).

Had it been proposed to satisfy [...] taneously the conditions

$$9x-15y=2 \ldots\ldots\ldots\ldots (2)$$
x and y are integers...... (3)

we should have found that *no* [...] could be assigned to x and y suc[...] fulfil them (*c*). And yet this qu[...] involving only one condition ex[...] in the form of an equation betw[...] and y, is, in its form, an indeter[...] one. The nomenclature of this [...] Algebra seems to be defective; a[...] clear that the use of the term *un*[...] instead of indeterminate would be [...] open to objection.

The term *Diophantine Alge*[...] sometimes used as identical with "[...] terminate analysis" (*d*); and som[...] the word *Diophantine* is applied [...] species of unlimited problems, [...] pally respecting square and cub[...] bers" (*e*). On the other hand [...] writers do not use the word "Di[...] tine" in connection with this spe[...] question (*f*).

Without going further into th[...] ject of Nomenclature at pres[...] shall proceed to offer a few rema[...] the Exercise which I gave at page [...] 15. Suppose, then, that we om[...] words "*by unity*" which occur [...] third line of that Exercise (*g*); [...] its three last lines substitute th[...] lowing:

Give a solution for the case wh[...] number of beasts bought by the third [...] is the square of the number purch[...] each of the others.

(*a*) These values are $x=\frac{449}{138}$ and $y=\frac{251}{138}$. The numerators of these fractions are prime numbers.

(*b*) Wood's *Algebra* (10th ed. 1835) page 296, Ex. 1.

(*c*) See an English translation of EULE[...] *ments of Algebra* (London, Johnson and C[...] 2nd. edition), vol. ii., pages 19—20, arts. 2[...]

(*d*) Ibid., vol. ii., p. 245, first paragrap[...] "Advertisement" to LAGRANGE'S *Add*[...] the work mentioned in the last note.

(*e*) Bridge's *Algebra*, (6th ed. 1826) p[...] Art. 152.

(*f*) It is not used in the Chapter "On U[...] Problems" in the 10th ed. of WOOD's *Alge*[...] in the corresponding Chapter of Kelland's [...]

(*g*) *Supra*, page 14, line 6 from the botto[...]

:=number of beasts bought by the d second) farmer,
=price paid for each beast by the ner,
umber of beasts bought by the third

first sight this would appear to ırely indeterminate question,— ned by a single equation between determined quantities x and y. espect to x indeed the number ions is *unlimited;* but with re- y we are restricted to the values ıtisfy the equation

$$2-y^2=1;$$

consequently thrown back upon rcise as announced at pages 14— hich, if we assume that x^2 is the of beasts bought by the third we shall arrive at an *identity* (*h*) ttain the required result.

on looking at the Exercise as ly announced, we see that if tal number of pounds paid by the nd farmer

$x-1$) and $f(x^2)$ will respectively ıt the total number of pounds the first and third farmers; and rcise is connected with the func- uation

$$-1)f(x)=f(x^2) \ldots\ldots\ldots (4).$$

y perhaps interest some of your if I give a solution of the sim- ıe of this equation—which in fact ɔnds with the question involved Exercise.

me that $f(x)$ is of the form

$$\alpha+\beta x+\gamma x^2+\&c.,$$

t let

$$f(x)=\alpha+\beta x$$

sequently

$$f(x-1)=\alpha-\beta+\beta x$$

$$f(x^2)=\alpha+\beta x^2,$$

condition (4) conducts us at once ɔllowing,—

$$\beta)=\alpha \quad , \beta^2=\beta, \beta(2\alpha-\beta)=0$$

ıich we see that, if we reject zero ue of β, the function f cannot be orm last assumed; hence, let us that

$$f(x)=\alpha+\beta x+\gamma x^2$$

$$f(x^2)=\alpha+\beta x^2+\gamma x^4 \text{ and}$$

$$1)=\alpha-\beta+\gamma+(\beta-2\gamma)x+\gamma x^2$$

and since γ must not vanish we obtain at once

$$\gamma=1$$

also, rejecting $\alpha=0$, we have

$$\alpha-\beta+\gamma=1 \text{ or } \alpha-\beta=0,$$

and the condition given by the terms in x^2 is consequently, since $\alpha=\beta$,

$$1-\alpha+\alpha^2=\alpha \text{ or } (\alpha-1)^2=0$$

hence $\alpha=1$; and with the above values of α, β, and γ, the co-efficients of x and x^3 on the left hand side of the development of (4) become zero. And the simplest solution of the functional equation (4) is

$$f(x)=1+x+x^2$$

$$=x(x+1)+1$$

the function which occurs in the Exercise.

I now propose to make a few remarks on the subject of *irrational* equations and to apply to the results deduced from them the same principles of selection (which we have already found to be of some service,) as in other cases (*i*). This is a question of, perhaps, some little interest since the first instance in which we have found those principles entirely at fault is one in which y is given as an *irrational* function of x (*vide supra* page 14).

Let there be given (*j*)

$$x+\sqrt{5x+10}=8 \ldots\ldots\ldots\ldots\ldots\ldots (5)$$

$$\therefore \quad 5x+10=(8-x)^2$$

$$=64+16(-x)+(-x)^2$$

$$\text{or } (-x)^2+21(-x)=-54$$

$$\text{or} \quad -x+\frac{21}{2}=\sqrt{(+1)^2\left(\frac{21}{2}\right)^2-54}$$

$$\therefore x=\frac{1}{2}(21-15)=3$$

the true result; the other value of x is 18.

Let there be given (*k*)

$$3x+\sqrt{2x-2}=7 \ldots\ldots\ldots\ldots\ldots\ldots (6)$$

$$\therefore 2x-2=49-42x+9x^2$$

$$\text{or } 9x^2-44x=-51$$

$$\text{or } \left(3x-\frac{22}{3}\right)^2=(-1)^2\left(\frac{22}{3}\right)^2-51$$

$$\text{or} \quad 3x-\frac{22}{3}=-\frac{5}{3}$$

$$\therefore x=1\frac{8}{9}$$

the true result; the other value of x is 3.

'e make z=number of beasts bought by armer we shall also have $z=-(x^2+1)$ for ; but this last is not an available result.

(*i*) *Supra*, pages 13—14; vol. xlvi., pages 491, 516.
(*j*) Wood's *Algebra* [Lund's (12th) ed. 1845] page 113; 10th edition, page 80.
(*k*) Ibid. page 128 of Lund's Edition.

But $x=18$ is not a solution of (5) nor is $x=3$ a solution of (6). These latter values belong to the equations formed from (5) and (6) by changing the sign prefixed to the radical from positive to negative (*l*). But when *both* the values of x belong to *one* of the related equations a difficulty arises; thus, let (*m*)

$$y+\sqrt{10y-71}=5 \quad . \quad . \quad . \quad . \quad (7)$$

the solution of this equation obtained in the same manner (*n*) as those of (5) and (6) is

$$y=8$$

a value which does not satisfy (7). In fact both this value and the value $y=12$ belong to the related equation

$$y-\sqrt{10y-71}$$

which is satisfied by each of them (*o*). I shall take another opportunity of resuming my remarks on these equations, and in the meantime would advise those who take an interest in discussions of the present subject to consult a paper by HORNER (consisting of a letter to Professor Davies) published at pages 43 *et seq.* of vol. viii. of the *Philosophical Magazine*, (Series iii.). The learned Editor of the last edition of WOOD'S *Algebra* has fallen into an oversight in treating a part of the subject of irrational equations. The error (which occurs in the first paragraph page 129) originates in a fallacy, the nature of which was very clearly pointed out by the illustrious HORNER in the *Philosophical Magazine* (*p*).

(*To be continued.*)

Note.—In I. of the *Horæ Algebraicæ* (*supra* page 13) I have made the references in the notes wrongly. The reader will be pleased to substitute for "*Ante*" the correct reference, which is "vol. xlvi."

IMPROVED LOCK GATES.

Sir,—In number 1246 of your Magazine is a description of Lowthorp's wicket-gate for canal locks. While using the same principle in the construction represented in the following sketch, I submit that it is employed with greater simplicity and effect.

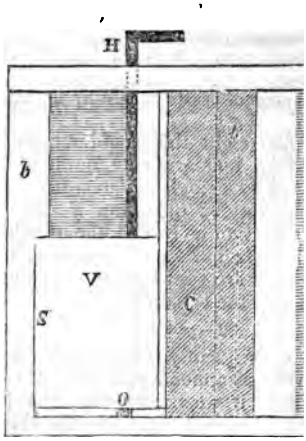
(*l*) WOOD, 10th ed., p. 81; Lund's ed., pp, 113, 128.

(*m*) This is a simpler form of the equation given at line 6 of page 123 of WOOD'S *Algebra* (12th ed.).

(*n*) Although there is a slight difference in the manner in which (5) and (6) are solved, yet the principles involved are essentially the same.

(*o*) WOOD, (Lund's ed.), p. 128.

(*p*) *Vide* pages 188 *et seq.* of vol. v. and 48 *et seq.* of vol. viii. of the third Series of that work.



The figure represents one ga lock, viewed from the lower leve are two main beams; V is a fla turning horizontally on an axis t its centre; it abuts on the out one beam and the inside of the oth is so hung that the fluid pres greater on one side of the axis tl other. The pressure then bei wards the sluice will rest in t sition represented. Now to op valve there is a chamber C forme box, the water-tight lid of w that part of V which is pressed it. If we turn a cock and so let th pass into C, it is plain that the p on this lid will be the same o sides, and the fluid pressure on V greater on the side S of the ax will thus open the sluice. Wh water rises to the same level ins outside of the lock, the valve V b free and may be returned to its pla slight force at the handle H; the fo cock being turned to empty the ch C, and bring the whole (as the sinks) to its original condition. Th pletion of further details will be suggested to any mechanical min the formation and the practical this sluice appear to me devoid o plexity.

I am, yours, &c.

JOHN MACGRE

Battersea, July 16.

A QUESTION FOR "A. H."

Sir,—I suspect that I have "A. H." napping; but shall fore ther observations upon *dormitat H*

nay suit his convenience to ex- re fully the principle laid down ı the first column of the fourth 'our current volume, and com- the fortieth and three follow- , and to answer this question, ing combustion as in common d a rocket ascend in vacuo?"

I am, &c.

JOHN MACGREGOR.

., July 16.

OF PREMIUMS—ROYAL AGRI- CULTURAL SHOW.

: to see their own works surpassed, and ·ly do they dislike to have them ad- be so, and by, perhaps, sometimes pre- : incompetent persons."

The Eureka—Vide ante page 65.

[know not whether the Nor- judges were desirous of adding ıt of their practical testimony Hint from Brother Jonathan," ; the evil tendency of *premiums*, :h the above quotation is taken. ı been their object they could ve accomplished it more effec- n by their extraordinary deci- adjudications upon the relative the numerous ingenious imple-)mitted to their examination at t meeting of the Royal Agri- Society. One, out of many ases has amply revenged itself, y proper and spirited Resolution ıs agreed to by some of the ıted of the Exhibiters,—a copy appears in your last number ł). The important character of ine, the considerable amount of , and the manifest injustice of l, rendered this a proper case : animadversion.

unately this was by no means a ase of injustice, as the greatest :tion prevailed, generally, at the in which the premiums were The evil appears to have well from the prejudice, as incompetency of the judges; incompetency, I believe, they pon the other point little dif- f opinion prevails.

; myself, on this occasion, been the number of those whose lot cast pearls before swine, my at- as naturally directed to the con- ıe judges, whose favours were distributed among a small "regular customers" (*i. e.* persons who follow the Society annually to all parts of the kingdom), while new comers, whatever the novelty or merit of their machines, stood but little chance—especially with men who only profess to be excellent judges of,—Horse and Hog's flesh!

In endeavouring to make such a distribution of the good things at their disposal among their old friends and patrons, as should keep them all in good humour, the judges have most notably failed.

It was stated that in one instance, feeling themselves somewhat embarrassed how to decide, the judges resorted to a common, though not very respectable expedient, and, by tossing up a halfpenny, solved the difficulty! A potato washer won the *toss;* but lost the *prize,*—the judges afterwards discovering that they had no prize left at their disposal!

In the "New Implement" (a Farmer's Fire-engine) which I exhibited to the Northampton Meeting, merit was claimed for, among other advantages, extreme portability, non-liability to derangement, facility and certainty of action, efficiency, and cheapness; in all of which respects it was without a rival. The judges put in competition with the foregoing an old implement, which has been exhibited year after year, displaying no particular novelty or merit, but which they thought worthy of a silver medal! At my earliest convenience I propose to lay before your readers a description of my new engine, with full faith in their ability to appreciate, and honesty to acknowledge merit wherever it exists. I may perhaps be permitted to say that the engine was greatly admired and warmly eulogized by many of the nobility and gentry visiting the exhibition.

Although somewhat personally interested, these remarks are penned solely on public grounds, for one thing I think is certain, the Royal Agricultural Society must either discontinue the award of Premiums, which is, after all, as brother Jonathan states, a practice "more honoured in the breach than the observance;" or, they must appoint impartial and competent judges to preside over the several distinct departments of the Show.

Let skilful graziers sit in judgment upon fat sheep, pigs, &c. Let practical farmers decide upon the respective merits of ploughs and harrows; but let engineering implements be subject to

the examination of engineers of known talent and impartiality.

Much mischief has doubtless been perpetrated; but the *public* are, after all, the real judges, and, by their discriminating selection, mark their thorough contempt for the adventitious distinction of "PRIZE IMPLEMENTS."

I am, Sir, yours, &c.,
WM. BADDELEY.

19, Alfred-street, Islington,
August 2, 1847.

SIBLEY AND RUTHERFORD'S EARTHWORK TABLES.*

The name of Mr. Sibley—though not unfamiliar to London circles, as that of a gentleman in extensive employment, and sound practical knowledge—is probably new to the scientific world at large. Not so, however that of his colleague, Mr. Rutherford, who enjoys a European celebrity both as a profound mathematician and an able calculator. His computation of the circumference of the circle to 208 decimal places, is a work without a parallel. We have heard it styled an affair of mere labour; but this is to underrate it vastly—for, without the employment of the most refined artifices, it would have assuredly transcended all human power—all human patience. The fact of Mr. Sibley's being associated in the present undertaking with a gentleman of Mr. Rutherford's high standing, may be safely accepted as evidence sufficient of his also possessing talents deserving of more than a mere local reputation.

No one knows better than Mr. Rutherford how to bring the higher mathematics to bear upon the practice of calculation; and, therefore, it was with no small degree of satisfaction that we read the announcement of this set of tables as being computed and arranged with his assistance, and (we presume) under his general superintendence. This is another instance of the *practical tendency* of mathematical minds in our own day, and upon which we have already some remarks in a review of Mr. Bash Tables (p. 15). We hope to see thi dency still further developed amongst tific men, and that the *curiosities* of matics will be merged in inquirie possess more or less *social utility*.

We presume that these tables hav calculated in duplicate, which, indeed principal advantage to be derived fr persons being employed upon then addition to the security afforded by dependent computations by differen sons, the authors state that they have them by "the method of differences places of decimals, and then tabul the nearest unit." We may, the trust with implicit confidence to thei racy.

The tables are computed for all th slopes, with a central width of 33 fe an additional table for the cases widths from 23 to 43 feet. A simp is given for obtaining the content *slopes;* so that the tables are, in applicable to all probable widths and of the cutting. The authors have all adapting formulæ (which they ap consider as mere petty excuses fo calculation), under an impression tha ever ingenious such transformatio be, they are incompatible with tha racy and certainty of result which essential to all practical processes. it a slight improvement upon all pr methods, that the *entire content* of of the cutting is taken out of the ta inspection, instead of requiring tw bers to be taken from separate tab added together. Not only is time but a fruitful source of inaccuracy r thereby. The tables themselves are ple and easy of use as a table of log requiring only two arguments (the at each extremity of the chain) fo the required content of the chain-le the cutting.

These tables appear to us not onl ed to the immediate purpose of de ing the actual content of work alrea

* Tables for Estimating the Contents in Cubic Yards of the Earthwork of Railways and other Public Works. By Charles K. Sibley, C. E., Assoc. Inst. C. P., and William Rutherford, F.R.A.S. Royal Military Academy, Woolwich. Longmans: 1847.

s infinitely better calculated than
ı processes usually employed, to
ı *unimpeachable* estimate of work
ıe, to be laid before Parliament,
sanction is required for any public
ng. Every one conversant with
mentary history of railways knows
rtance of this; and too many to
r cost.

ture of the tables will be apparent
following formulæ from which they
computed: the first three for all
a and b from 0 to 60 feet, with a
dth of 33 feet:

$$\frac{22}{7}(a^2+ab+b^2)+\frac{121}{3}(a+b).$$

$$\frac{11}{9}(a^2+ab+b^2)+\frac{121}{3}(a+b).$$

$$\frac{44}{27}(a^2+ab+b^2)+\frac{121}{3}(a+b).$$

$$\frac{11}{9}(a+b).$$

it is the content of the central
foot in width, for the purpose of
or diminishing the previous tables
idths of the central part of the

l intended to give the investiga-
hese formulæ; but they are really
as to render it unnecessary, and
re omit them.

lusion we most cordially recom-
e tables to the use of the profes-
lfilling the conditions of accuracy,
, and applicability in as great a
we think it likely these conditions
e fulfilled.

In our review of Mr. Bashforth's
eady referred to, we had over-
it is evident that able mathema-
l himself done) that his method
case apply to the depths regis-
is table—at least, in the ordinary
e word "depth." His depth is
not to the road itself, but to *the*
n of the slopes below the road.
a instance: Suppose the slopes
1 to 1; then the depth of the
a which Mr. Bashforth measures
is, for a central part of 33 feet, just $16\frac{1}{2}$ feet below the road; thus reducing his 65 feet table to $48\frac{1}{2}$ feet. We mention this with no intention to detract from the value of Mr. Bashforth's table, nor with the slightest wish to modify in the slightest degree the expression of our estimate of the ability displayed in its composition; but simply to apprize those who use it, of a circumstance that might, if unobserved, lead to an inaccurate estimate.

IMPROVEMENT IN RAILWAY BUFFERS.

Sir,—I have perused with much interest the communication of Mr. Sutton to the Editor of the *Sun*, dated 20th of June, 1845, to which he referred me for a description of my concave and convex buffers which appeared in a recent number of your excellent Magazine. I am not inclined to relinquish my right of invention in consequence of anything appearing in the said letter, and it must be evident to your readers that Mr. Sutton's plan is not identical with the one I have had the honour of suggesting through the medium of the *Times* and your Journal. He says, "*If these buffers are furnished with a plug and key sort of adjustment they may, when a severe shock takes place become firmly keyed or locked into each other, and thus the whole line of carriages, at least those which are in the vicinity of the shock, will become as one body immovable, no running over each other or overturning, as they are as one carriage firmly united with the buffers, but which may be instantly disconnected by suitable gear.*" Now, Sir, the difference consists in this, that in Mr. Sutton's arrangement the buffers become firmly locked in one another whenever a collision takes place, and are in every instance to be disconnected by hand, &c. An arrangement of that nature would not answer the purpose, as any one conversant with railways can testify. If the carriages were to become locked every time the buffer springs were acted upon, it would be necessary to have a guard to attend every buffer. Now, in my plan there would be no necessity whatever for any mechanical arrangement more than having *concavity* to meet *convexity*. The buffers would be released and locked according to the disposition of the train. That such will be the plan adopted ultimately I have every reason to believe, and I feel assured that it will prove superior to the plan now in use, and thereby diminish, to some extent, the risks of acci-

dents in the case of sudden and violent collisions.

I am, Sir, your obedient servant,
O. ROWLAND.

July 31, 1847.

AERIAL NAVIGATION.

Sir,—I had intended to make a few remarks upon the impracticable aërostatic plan of Mr. Pitter; but I find those of your correspondent "Argus," at page 106 of your last Number, so pertinent, that I will not trespass on your space with vain repetitions. In reviewing past attempts, however, "Argus" refers to various difficulties in the way of directing balloons or aërostats, which certainly did exist in all the schemes hitherto submitted for that purpose. They are not, however, insurmountable; and if "Argus" will refer to a communication of mine, written eleven years ago (vide *Mech. Mag.* No. 689, vol. xxvi., p. 39), he will see that, while I perfectly agree with him as to the principles upon which aërial navigation must inevitably depend, I profess to have perfected such an improvement in the form and arrangement of the aërostatic machinery, as to render suitable propelling power available for its direction.

The power of propelling vanes was established by Tatum, and publicly shown in his lectures, some thirty years ago, and more recently at the Polytechnic Institution, by Mr. Green; but no one has shown how this known fact can be made applicable to the purposes of aërial navigation.

So long as the public are content to pay their money to gaze at balloons, as a species of puppet-show—increased in interest in proportion to the buffoonery or fool-hardiness of the aëronaut—we shall look in vain for any practical improvement in the *science* (?) of aërostation.

In conclusion, I would beg to say, too much importance cannot be given to the suggestion of "Argus," for adapting springs to the cars of balloons, to obviate the violence of the shock on striking the ground. The best form of spring would be a series of air-cushions, which, laid upon strong net-work, might form the floor of the car, covered by a piece of oil-cloth as a protection; these, in the event of a rapid descent, would effectually avert unpleasant consequences. No other elastic material could be employed, without an objection arising to its weight.

I am, Sir, yours, &c.,
WM. BADDELEY.

29, Alfred-street, Islington,
July 31, 1847.

QUESTIONS IN FRICTION.

Sir,—I have no doubt but answers to the following questions will interest many of your scientific readers as well as much oblige yours truly,

A CONSTANT READER.

1st. Taking 8 lbs. per ton as the friction of a Railway Carriage, the wheels rolling, what would the friction of the same carriage amount to per ton with the wheels all sliding?

2nd. Does the number of wheels affect the question, whether 4 or 6?

3rd. Is the friction increased by the increase of rubbing surface, the weight remaining the same?

4th. Is the momentum of a locomotive as readily destroyed by the driving wheels revolving the reverse way (the engine still advancing by momentum), as if the driving wheels were sliding?

CALENDAR OF SPECIFICATIONS OF PATENTS OF INVENTIONS. FROM THE PERIOD WHEN THE PRACTICE OF ENROLMENT COMMENCED TO THE PRESENT TIME.—CONTINUED FROM P. 118.

[From the Reports of the Deputy-Keeper of the Public Records (Sir Francis Palgrave).]

THE CALENDAR.

[Of the two dates annexed to each entry, the first is the date of the patent, and the second that of the enrolment of the specification.]

Andrew Meikle, of Knowsmill (East Lothian, North Britain), engineer and machinest: of a mill or machine for separating corn of all kinds from the straw, which machine is capable of being worked either by cattle, wind, or water, or any other power, whereby the corn may be separated in a less time and in a more effectual manner than by threshing. Cl. R., 28 Geo. 3, p. 1, No. 1. April 9, 28 Geo. 3; April 29, 28 Geo. 3, 1788.

Edward Troughton, of Fleet-street, mathematical instrument maker: of a new method of framing (composed of double parallel flat bars connected by cocks or pillars) to be used in the construction of octants, sextants, and quadrants of every denomination, and all other nautical and astronomical instruments whose limb or limbs is or are formed of a circle, or any part of a circle. Cl. R., 28 Geo. 3, p. 2, No. 2. April 1, 28 Geo. 3; April 28, 28 Geo. 3, 1788.

John Tencate, of Great Mary-le-Bone-street (Middlesex), engineer: of a horse pump calculated to raise from ten to one hundred hogsheads per minute, on the principle of a fulcrum balance worked by a cas-

, performing a double attraction in revolution. Cl. R., 28 Geo. 3, 8. May 5, 28 Geo. 3; May 14,

Fulton, Broommuir, Airshire, mar: of a new method or art of using ing pumps, as well on board of ships ., rubbing boards used in bleaching, ther mechanical machines, or en-similar natures or constructions, by a cylinder (grooved) with its ap-Cl. R., 28 Geo. 3, p. 4, No. 3. 28 Geo. 3; June 23, 28 Geo. 3,

White, of Holborn, Engineer: of new improvements in mechanic pplied to, and tending to ameliorate of clocks, watches, and time-pieces, roasting, cranes for raising heavy and other purposes. Cl. R., 28 . 4, No. 2. May 20, 28 Geo. 3; 1788.

s Blaikie, of Glasgow, merchant: vention of an ingredient to be used stitute for gum in thickening of for printing (linen, calico, &c.), ll answer all the purposes of that t a much more reasonable rate. 8 Geo. 3, p. 4, No. 1. June 11, 3; July 4, 1788.

Tylee, Marylebone, shoemaker: slipper, and buckle to be affixed nd worn therewith, on a new con-, which will sit neater and easier hitherto discovered. Cl. R., 28 p. 5, No. 2. June 30, 28 Geo. 3; 1788.

m Hanscombe, citizen and saddler n: of an invention on a mathemati-iple for roasting a great number of meat, fowls, &c., horizontally and . Cl. R., 28 Geo. 3, p. 6, No. 11. 1788; Aug. 22, 28 Geo. 3, 1788.

s Lewis Ducrest, of Jermyn-street, ster: of an invention of making r the building of houses, bridges, ats, and all sorts of wheel carriages, airs, chairs, tables, and bookcases, ntirely of paper, or wood and iron with paper. Cl. R., 28 Geo. 3, . 3. Aug. 12, 28 Geo. 3; Sep. 9,

Cook, of Wapping, spunge-maker: invented elastic spunge, for spung-guns, and other fire-arms, which able to be damaged by water or and will last considerably longer r spunge heretofore constructed or . R., 28 Geo. 3, p. 6, No. 2. Aug. eo. 3; Sep. 26, 1788.

s Howe, of Tavistock-street, Co-den, chemist and druggist: of a for the cure of consumptions, asthmas, coughs, and other disorders, called (by the specifier) Howe's Pectoral Lozenges of Horehound. Cl. R., 28 Geo. 3, p. 6, No. 1. Oct. 6, 28 Geo. 3; Oct. 22, 1788.

William Hele, of Kingsbridge, Devon: of a drill machine for sowing grain, or any kind of seeds. Cl. R., 28 Geo, 3, p. 8, No. 15. Oct. 29, 29 Geo. 3; Nov. 15, 1788.

James Rumsey: of certain new methods of constructing boilers for distillation and other objects, and for steam engines for various purposes. Cl. R., 28 Geo. 3, p. 8, No. 11. Nov. 6, 29 Geo. 3; Dec. 6, 29 Geo. 3, 1788.

James Yates, of Bordsley, near Birmingham, brass-founder; of a new method of multiplying engravings or chasing on all kinds of metals, particularly applicable for the engravings or chasings on the ornaments of coaches and coach harness, and many other purposes where engravings or chasings are required. Cl. R., 28 Geo. 3, p. 15, No. 1. July 8, 28 Geo. 3; July 31, 1788.

William Dufour, of Cantshill, Bucks, gent.: of a machine called a fire-escape, for the preservation of life and property from the dreadful effects of fire. Cl. R., 28 Geo. 3, p. 22, No. 1. June 10, 28 Geo. 3; July 7, 1788.

John George Hohmann, of Rotherham, Statuary: of a new machine for making marbles for children from various sorts of marble and other substances. Cl. R., 28 Geo. 3, p. 28, No. 17. Jan. 15, 28 Geo. 3; Jan. 22, 1788.

David Yates, the younger, of Manchester, lining cutter and small ware manufacturer: of a machine for glazing or polishing cottons, linens, and mixtures, or cloth made either of cotton or linen, and cloth made of cotton and linen mixed together, and also all sorts of cloths or stuffs made of cotton and linen, or either of them, and any other material or materials of any width or breadth to two yards wide or broad, or of a greater breadth or width. Cl. R. 28 Geo. 3, p. 29, No. 1. April 22, 28 Geo. 3; May 14, 28 Geo. 3, 1788.

John Curr, Sheffield, gent.: of a new method of drawing or raising coals, lead, tin, or any other minerals out of mines, and of landing such minerals, and for other purposes mentioned in the letters patent. Cl. R., 28 Geo. 3, p. 33, No. 1. Aug. 12, last past; Sep. 6, 28 Geo. 3, 1788.

Edmund Cartwright, of Doncaster: of certain additional improvements on specifier's machine for weaving. Cl. R., 28 Geo. 3, p. 36, No. 5. Nov. 12, 29 Geo. 3; Nov. 14, 29 Geo. 3, 1788.

Robert Fourness and *James Ashworth*, of Halifax, gents.: of a steam or fire engine,

comprising three or any greater plurality of cylinders with the appendages thereto—capable of being commodiously applied to the purpose of conveying or impelling travelling carriages of every denomination, or giving circular or other motions without the assistance of a fly, and without being burthened with cold water for condensing the steam. Cl. R., 28 Geo. 3, p. 36, No. 1. Nov. 6, 29 Geo. 3; Dec. 6, 1788.

Mary Howson, of Tottenham High Cross, Middlesex, widow: of an invention (communicated to the specifier by her brother, Isaac Lascelles Winn, of the Island of Jamaica), of certain universal and perpetual principles of saving fuel in the heating, boiling, or evaporating all kinds of fluids, and certain new invented stills and boilers. Cl. R., 29 Geo. 3, p. 3, No. 1. June 9, 29 Geo. 3; July 8, 1789.

William White, of Garlick Hill, London, tallow-chandler: of a machine by which the noxious or foul air may be expelled in a short interval of time from any mine, ship, gaol, hospital chamber, or other close place, and fresh cool air introduced in its stead, however calm the atmosphere, or however warm or sultry the season or climate. Cl. R., 29 Geo. 3, p. 4, No. 15. May 12, last; June 11, 1789.

John Elin, of Pimlico, in the parish of Saint George, Hanover-square, gent.: of a machinery for cleaning the inside of chimneys. Cl. R., 29 Geo. 3, p. 4, No. 13. May 28, last past; June 25, 1789.

Henry Seymour Conway: of an entire new method of adapting or conveying the heat arising from the fire of coal employed in coke ovens (by a particular construction of such ovens and flues adjoining thereto or connected therewith) for the working of steam engines, baking of bread, meat, or other food, calcining or fusing of ores and metals, making of brass or steel, as also for the purpose of warming of rooms, staircases, or large buildings, heating water for baths, and which is applicable to many other useful purposes, and manufactories requiring the assistance of fire or heat, by which means the expense of the coal or other fuel, which hath hitherto been necessary for the above operations, is entirely or in the greatest part saved. ,Cl. R., 29 Geo. 3, p. 4, No. 2. June 23, 29 Geo. 3; July 20, 1789.

John Elin, of Pimlico, gent.: of an improvement to shoe-buckles. Cl. R., 29 Geo. 3, p. 4, No. 1. Aug. 29, last past; Sept. 23, 1789.

William Shorland, of Bristol, Esq.: of a regular rotary motion to go by a steam engine without any crank or cog-wheel, the machinery of which is to be fixed upon new invented gudgeons and brasses. Cl Geo. 3, p. 5, No. 1. July 30, 29 Aug. 29, 1789.

James Norton, of Berners-stree profluvium box for the purpose of su carriage and all other kind of whe oil, by which means there is a (flowing, or flux and reflux. Cl. R., 3, p. 6, No. 10. Aug. 27, last past 26, 1789.

Robert Cameron, of Lambeth, e of new invented improvements on thods of raising coals, ores, and wa likewise certain new machinery for th ing of coal mines. Cl. R., 29 Geo. No. 9. Sept. 5, 29 Geo. 3; Oct. 2, 3, 1789.

Moses Hart, gent., of Southwar new and particular method of manuf the sediment commonly called the b foots, or slush of whale oil, taken f bone whale, or the sediments of sea of any other fish oil, and extracting, ing, and purifying, and whitening th chiefly for the purpose of making Cl. R., 29 Geo. 3, p. 7, No. 8. 30 Geo. 3; Nov. 23, 30 Geo. 3, 17

Samuel Hands, of Wirksworth (I of new invented spring shoe buckle useful and convenient than the buck in use. Cl. R., 29 Geo. 3, p. 11, May 2, 29 Geo. 3; May 30, 1789.

John Bulkeley, of Chester, wi chant: of an ornamental steel case, ward covering for the heels of shoes, and slippers of men, women, and cl to be made of silver, gold, plated i other metals, which may be wore plain or decorated, and will give ad stability and security, as well to the boots, and slippers, as to the feet wearer, without the inconvenience of derous incumbrance. Cl. R., 29 Ge 14, No. 1. July 30, 29 Geo. 3; A 1789.

Thomas Todd, of Owthorpe (N ham): of a machine on a new const for the making of screws and nut boxes for screws. Cl. R., 29 Geo. 3 No. 15. July 7, 29 Geo. 3; July Geo. 3, 1789.

Samuel Boulton Harlow, of Ash (Derby), watchmaker: of an inven making watch-keys upon a new co tion, by means of a spring, so as to p watches from injury when keys are the wrong way. Cl. R., 29 Geo. 3, No. 7. Nov. 6, 30 Geo. 3; Dec. Geo. 3, 1789.

John Mannall, of Colchester, join cabinet-maker: of a machine or called a windlass-wheel, which being or placed to an engine or crane for

ss or weights, will lift more pon- and heavy burthens than any engine e, for the like purpose ever invented. Cl. R., 29 Geo. 3, p. 20, No. 11. June 9, 29 Geo. 3; July 7, 1789.

(*To be continued.*)

LIST OF ENGLISH PATENTS GRANTED ON JULY 31, TO AUGUST 5, 1847.

Sandeman, of Tulloch Bleachfield, Perth, for certain improvements in the materials esses employed in dressing, cleaning, scour- bleaching certain textile fabrics, and the of which such fabrics are composed. July nonths.

ire Fletcher, of Birmingham, brass founder, mproved manufacture of speculums for urposes. August 3; six months.

'ule, of Sauchiehall-street, Glasgow, prac- ineer, for certain improvements in chairs railways, and in the fixing of the same. ; six months.

Bourne, of Derby, Derbyshire, for improvements in the construction of kilns for burning stone ware and brown ware. August 4; six months.

Arthur Boyle, of Birmingham, umbrella-frame maker, for improvements in the manufacture of buttons. August 4; six months.

Thomas Birchall, of Ribbleton Hall, Lancaster, for improvements in folding newspapers and other papers. August 5; six months.

James Simister, of Birmingham, manufacturer, for improvements in the manufacture of stays and belts. August 5; six months.

William Broadbent, of Manchester, for improvements in the manufacture of paper. August 5; six months.

DESIGNS FOR ARTICLES OF UTILITY REGISTERED UNDER 6 AND 7 VIC. CAP. 65.

No. in the Register.	Proprietors' Names.	Address.	Subject of Design.
1152	T. and C. Clark & Co.	Wolverhampton, iron founders	Secret axle pulley.
1153	William Tilke	Holborn, manager of the Holborn Baths	National economic bath.
1154	Edward Williams	Heneage-street, Spitalfields	Victoria septibus.
1155	Edward Nicholson	Bishop Auckland, Durham	Stock for a jumper drill.
1156	Edward Nicholson	Bishop Auckland, Durham	Jumper drill.
1157	James Clarke	Wellington-street, London	Hat suspender.
1158	W. Grounsell	Louth, machine-maker	Improved winnowing machine.
1159	James Basire, jun.	London, engraver	Improved blade protractor.

CONTENTS OF THIS NUMBER

LONDON: Edited, Printed, and Publis Joseph Clinton Robertson, of No. 166 street, in the City of London.—Sold b W. Galignani, Rue Vivienne, Paris; Ma Co., Dublin; W. C. Campbell and Co., Ha

Mechanics' Magazine,
MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 1253.] SATURDAY, AUGUST 14. [Price 3d.

Edited by J. C. Robertson, 166 Fleet-street.

DOULL'S PATENT RAILWAY AND STEAM-BOAT SIGNALS.

Fig. 6.

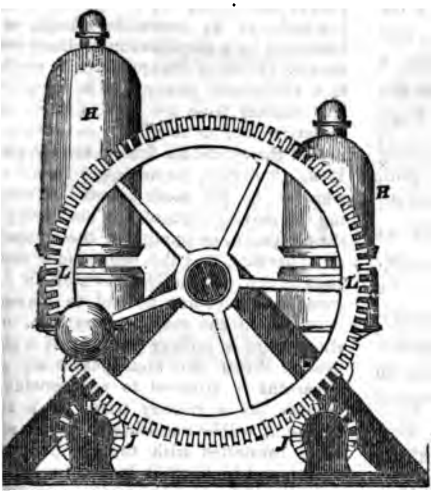


Fig. 5.

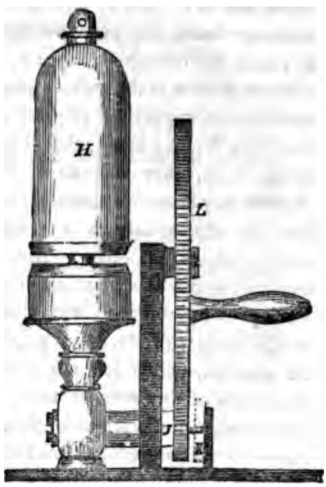
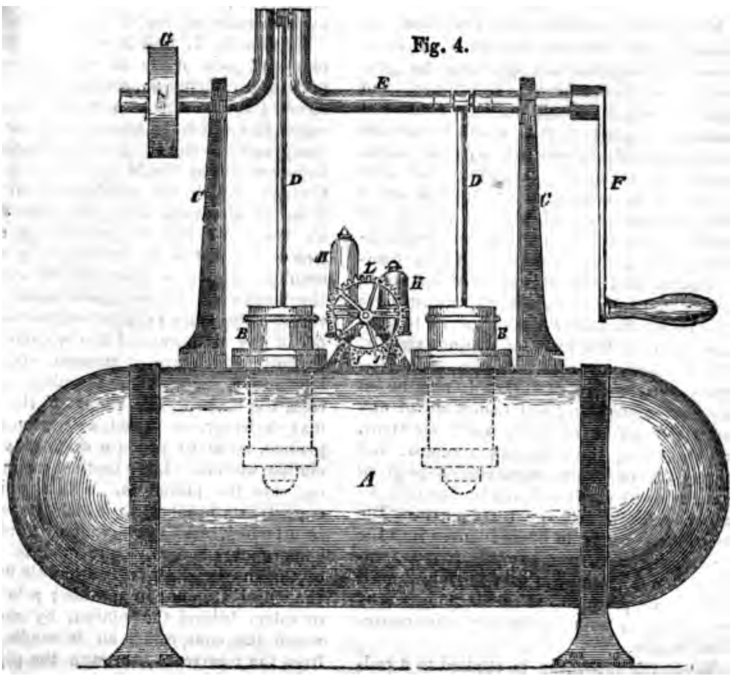


Fig. 4.



DOULL'S PATENT RAILWAY AND STEAMBOAT SIGNALS.

[Patent dated February 8, 1847. Patentee, Mr. Alex. Doull, C. E. Specification enrolled 8th August, 1847.]

Mr. Doull's plans have the indisputable merit of being exceedingly easy of accomplishment: air—which is always at hand, and to be had in any quantity for nothing—being the principal agent, and a pump to compress the air, with a whistle to blow it through, being all the mechanical appliances requisite. They have this further merit, that if you once adopt them, they will never fail you. Boilers may become exhausted, or burst; but the atmosphere is a reservoir as everlasting as boundless. Air, besides, can beat steam at a blast any day. We were present lately at a series of experiments made with Mr. Doull's compressed air whistles, which left not a doubt on the minds of any present that, in point of intensity and variety of tones, they possess a vast superiority over the steam whistles now in ordinary use.

Mr. Doull describes his invention as consisting in the employment of a compressed atmospheric air apparatus for producing audible railway, steamboat, and other signals, in a similar, or a somewhat similar, manner to that in which sounds are now ordinarily produced by the steam whistle of locomotive engines, and also in a mode, or modes, of varying the sound and producing several distinct sounds by rapidly opening and shutting the communication between the reservoir of the compressed air and the whistle; and further in a mode or modes of combining two or more whistles of dissimilar sounds, so as to produce an extended scale of distinct signals.

The vessel, or receiver, into which the atmospheric air is compressed, may be of any convenient size, and composed of any material capable of being made air tight, and sustaining the necessary pressure; and it may also have any convenient shape given to it, as cylindrical, with flat or hemispherical ends, or square, or rectangular. The atmospheric air is to be condensed into the receiver by an air-pump, or air-pumps, single or double-acting, as may be found most suitable in practice. The air-pumps may be worked by hand, or by any other convenient means.

When the apparatus is applied to a railway train, and placed in charge of th of the train, or of a person appoir pressly to attend to it, motion may l municated to the pumps from any part of the carriage by cranks and c ing-rods, or by eccentric wheels, bands, or by a combination of these modes. Or when the apparatus is en in a steamboat, power may be obta like manner from the moving parts steam-engine, or machinery in motio nected therewith, for driving the air- It will, however, be necessary in al whatever be the mode adopted of c ing the moving parts of any machine the air-pump, or pumps, of the com air apparatus, that the connections such as can be readily thrown off or gaged, and recourse be had to ma bour, as in the case, for example, stoppage of a railway train, or of a boat. When the atmospheric air apparatus is attached to any movi chinery, as a railway train, or a engine, it will be necessary to have a valve connected with the compress vessel, and to keep it loaded to be maximum pressure as may be necess the efficient sounding of the whistle.

Figures 1, 2, and 3 of the eng represent one mode in which the pressed air signal apparatus may b structed and worked. A is the recei vessel into which the atmospheric air compressed by the air-pump *b*, which supposed to be single acting; *c* is through which the condensed air from the air-pump along the tube *d* air vessel A; *e* is the connecting-r tween the piston of the air-pump a crank *f*; motion is given to the cra the handle *g*. *h h* are guide rods through the stays *i i*, attached to the der of the air-pump. *k* is a whistle to those which are at present atta locomotive engines and sounded by from the boiler. The shape of the may, however, be varied, as hereina plained, so as to produce distinct a similar sounds. L is a toothed wheel ing into the pinion *m*. *o* is a tri support, or bracket, to which the w is attached, and upon which it re This bracket is firmly connected to of the air-vessel A. *n* is a handle by the wheel L is put in motion; *p* is or valve, behind the pinion, by me which the compressed air is made from the receiver A, through the pi

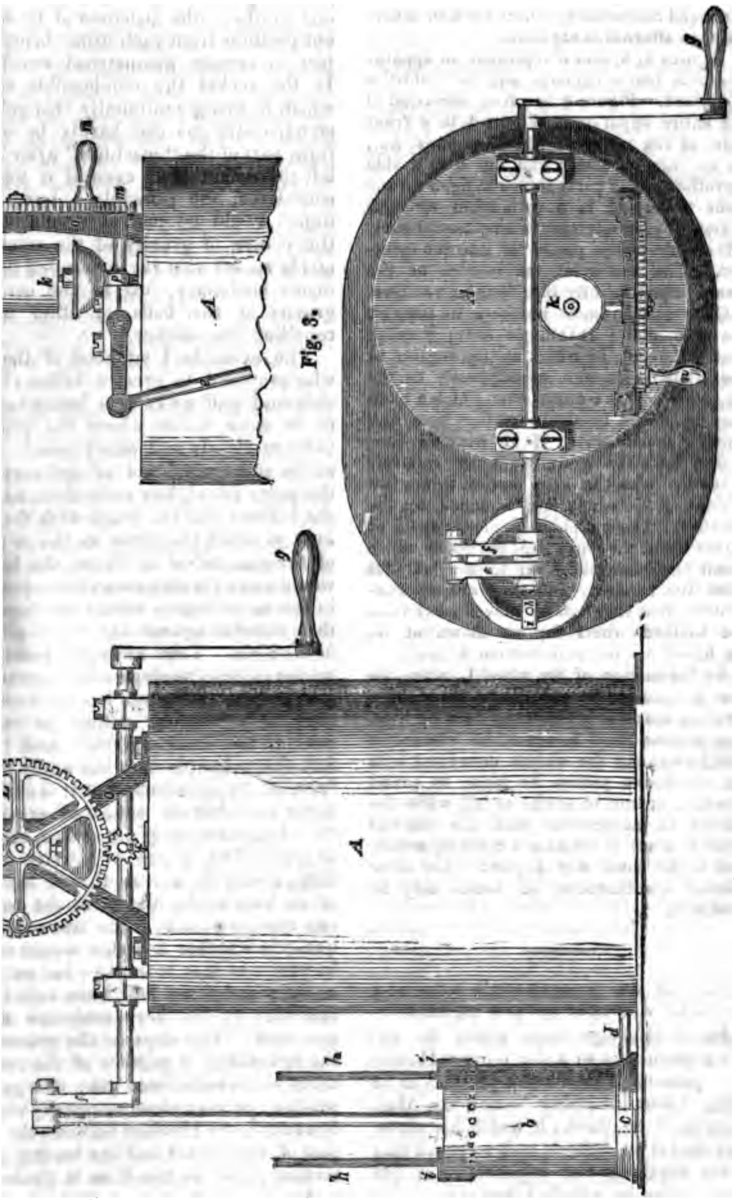


Fig. 3.

tle *k*. The pinion *m* is attached to
t, and when the wheel L is revolved

rapidly a thrilling sound is produced, which
may be so varied and combined with other

sounds as to form a gamut of considerable range, which may be still farther extended by a combination of two whistles of dissimilar sound connected by wheel-work or otherwise, as afterwards explained.

Figures 4, 5, and 6 represent an apparatus with two air-pumps and two whistles combined. Figure 4 is a front elevation of the entire apparatus. Figure 5 is a front view of the whistles, wheel, pinions, &c., on an enlarged scale; and fig. 6 is a side elevation of the parts shown in fig. 5 on the same scale. A is a cylindrical air-tight vessel, or receiver, with hemispherical ends. BB are air-pumps partly let into the cylinder. The valves at the bottom of the pumps open directly into the air receiver. C C are standards, or brackets, to support the crank-shaft; D D piston-rods; E crank shaft; F handle by which motion is given to the crank shaft, and consequently to the air-pumps. G is a drum, over which a band may be passed to obtain motion from any moving machinery. H H whistles connected with the compressed air receiver. L toothed wheel to give motion to the two pinions J J, which are attached to the whistles. These pinions are placed upon, or rather form, the handles of the cocks which admit the compressed air to the whistles from the receiver, and they are so constructed that they can be moved away from the toothed wheel L, as shown at K, fig. 6.

By the motion of the wheel L, when the two pinions are in connection therewith a thrilling sound is produced by both whistles. The pinions may, however, be alternately withdrawn, and the whistle connected with the withdrawn pinion be made to sound steadily, or not to sound at all while the whistle in connection with the toothed wheel is made to produce a thrilling sound. And in the same way a great many other peculiar combinations of sound may be produced.

REPLY TO MR. MACGREGOR'S QUESTION —COULD A ROCKET ASCEND IN VACUO?

Sir,—Although there would be nothing surprising in a far more "Homeric" personage than I can pretend to be being "found napping"—and Mr. MacGregor, if he thinks it worth his while, may find it no difficult task to prove that I am anything but infallible—in the present case he will find that "the principle" I have stated is perfectly correct. Mr. MacGregor has, I believe, misunderstood my meaning—perhaps from some obscurity in the wording. "machine" is meant any syst moving parts *invariably connecte* one another—the distances of the ent portions from each other bein ject to certain geometrical conc In the rocket the combustible which is being continually chang an expansive gas can hardly be form part of the "machine" *after* left the rocket—but even if it w considered, the principle I have tioned would be just as applicat the centre of gravity of the soli *of the rocket* AND *the expanded g* mains stationary, just as the ce gravity of two balls, or other repelling one another.

The example I adduced of th who proposed to erect a bellows ship and puff away at a board fa to its stern, is one where the pr is more clearly and easily seen. as in most machines of ordinar the parts are rigidly connected, n the bellows and the board with th Just as much therefore as the re of the current of air from the b would drive the ship *forwards*—pr in the same degree would the im that current against the board d *backwards*. Take away the boar let the current impinge solely agai atmosphere. We no longer hav *part of a machine acting on a part of the same machine*, and fore the principle does not apply form of the question—but it is sti fectly true that the centre of grav *the ship and mass of air moved*, re at rest. The centre of gravity ship moves forwards—that of the of air backwards, just as in the c two repelling balls. The answer question whether a rocket would in vacuo is that it would—*but no an external force* had been calle operation by the very evolution gas itself. The steps of the proce the following: A portion of the c sition is converted into gas; this g panding, exerts a pressure equally ir direction; the pressure between th part of the rocket and the issuing *mutual;* just as much as it pusl rocket forwards it pushes the ga backwards, and this latter action cisely that *external* force to wl have alluded. If you like to co

panded gas as still part of the
ine"—then the principle applies
ll force—the centre of gravity of
machine" *does not move one inch*,
the rocket may move a hundred
But, taking the word in its more
cceptation, then this *re-action*
the issuing gas is really an *ex*-
force, and one without which
ould be no motion of the rocket.
y, however, to see how extremely
ust be the velocity of a rocket in
where the re-action is the only
ch can be called into play. If A
he mass of the solid part of the
t any instant, B that of the por-
verted into gas, V the velocity
d by the pressure of the gas in
v that produced at the same

B, then $AV = Bv$, or $V = \frac{B}{A} v$,

s a very small fraction of v in
nning, but becomes greater as the
tion is more and more consumed.
MacGregor's mistake has evi-
been, in considering the gas as
the machine, whilst estimating
ing force, and then neglecting it
stimating the motion of the cen-
gravity *of that machine*. If it
dered part of the "machine" in
case, (which it must be, in order
the case under the head of the
iple" alluded to,) it must be so
ther. If the pressure of the gas
the rocket be considered as an
of "the action of one part of a
on another part," then also
centre of gravity *of that* "*ma*-
be considered *not* as that of the
lone, but as that of the *rocket*
together. And *this* point does
e at all; though both that of the
nd of the gas, considered sepa-
lo.

question of a somewhat similar
the present subject, I take the
nity of presenting the following
readers: "If a rope be fastened
n's waist, and passing over a
lley in the ceiling, return to his
e need only exert a force of half
ht to support himself, *and any*
effort will cause him to rise."
ell's First Principles of Me-
, p. 66.) Is the latter assertion
and if so show why it is so?
what force must be exerted to
raise himself? And what will be the
series of motions he must go through?

Yours, &c.,

A. H.

AERIAL NAVIGATION.

Sir,—The observations of "Argus" on my plan of aerial navigation, are conceived in so good a spirit, that, although his verdict is condemnatory, I must consider him more as a friend than an opponent. But, although I have only an ordinary pair of optics with which to compete with the hundred-eyed watchman of the gods, I yet think that I can discern some little instances of oversight in his observations.

About the appellation given to my machine, I will not dispute. "Argus" may have it "Archimedian Aerostat" if he pleases.

With regard to the effect of wind upon the navigation of a balloon, I think that the following fact should be more considered than it generally is, viz., that a balloon, unimpelled by machinery, is always at rest with respect to the air in which it floats, whether the air is in motion or not; and if a balloon is navigable at all, it is as navigable in a stratum of air in rapid motion as in one at rest. Its motion *in the air* and *over the earth* are two very different things; it is the latter motion only which shows the effect of the wind. So long as the velocity with which the balloon travels *in* the air is greater than the velocity with which the air travels *over* the earth, the balloon can be impelled towards any spot upon the earth, the rate of advance varying according to the direction of the spot, and the respective velocities of the air and the balloon. If the velocity of the air is greater than the intrinsic velocity of the balloon, the latter can only deviate laterally from the current. From these considerations, I do not see why the Archimedean screw should not be efficient for keeping the head of my machine pointed in the right direction. A navigable balloon can "feel" no wind but that which is caused by its own passage through the air. The wind is always "dead ahead," and the cylindrical form is perhaps less disadvantageous than some may suppose. It is evident that the "rude pressure of storms and tempests," to which navigable balloons have

been thought liable, exists only in the imagination.

In my answer to Mr. M'Gregor last month, "Argus" will find the dimensions proposed for my machine, and likewise some observations as to its stability.

"Argus" is afraid lest the carbonic acid gas evolved from a smoke-consuming furnace should "smother the aeronauts, from the way the mouth of the chimney is placed below the upper cylindrical bag." Having the mouth of the chimney low down is just the way to prevent such a catastrophe, carbonic acid gas being 1·52 times heavier than atmospheric air. But the necessity for such a contrivance seems likely to be obviated by Millholland's improved spark arrester, described in a late number of the *Mechanics' Magazine*. My object in proposing the consumption of the smoke, was to prevent the escape of sparks, which might fire the gas-bags.

When planning my parachute, I was well aware that Mr. Cocking had adopted the form of an inverted cone; but he was for placing the car low down, whereas I am for hanging it as high up as possible. I was led to the construction of my parachute, not from any consideration of what Mr. Cocking had done, but from the result of my own observations and experiments.

I did not state that "if *a* cylinder for gas be very large, the machine will become unmanageable," but that "if *the* cylinder, &c."—confining the observation to my own machine, and supposing the car and framework to remain fixed in size. I am by no means at issue with those high authorities who assert that large balloons are the best to navigate, seeing that the atmospheric resistance does not increase in so rapid a ratio as the buoyant power, a fact very encouraging to those who are endeavouring to solve the perplexing problem of aerial navigation.

Although the paddles of my machine are adapted to assist in lifting it, I yet fear that the most potent objection to it is, its want of buoyancy. This, however, as I have stated before, is a difficulty which I hope to conquer.

Trusting that your kindness will excuse my repeated intrusions on your columns, I am, Sir, yours, &c.,

JOSEPH PITTER.

Hastings, August 5, 1847.

HORÆ ALGEBRAICÆ. BY JAMES COCKLE, ESQ., M. A., BARRISTER-AT-LAW.

(Continued from page 136.)

III. NOMENCLATURE—SURD EQUATIONS—DIOPHANTINE ANALYSIS.

If we change the form of the equation (*a*)

$$(x^2+\tfrac{1}{2})^2=(y+\tfrac{1}{2})^2\ldots\ldots(1)$$

from the state in which it is above written, into

$$x^4+x^2+\tfrac{1}{4}=y^2+y+\tfrac{1}{4}\ldots\ldots(2)$$

the operation by which this change is effected is called EXPANSION; and, by analogy, the operation by which (2) is changed into (1) may be called CONTRACTION. The last term, were it generally employed would be found as useful as the former one: at least there are investigations in which its adoption would be of signal service. I may instance those in which we reduce any given expression to the form of a sum of algebraic powers—as is the case in some portions of my *Chapters on Analytical Geometry* (*b*).

Further — were the Nomenclature of Algebra *res integra* I confess that I should be inclined to make an alteration in the term "indeterminate" as applied to certain problems. A single equation between two undetermined quantities, subject to a limitation, condition, or restriction, as to the nature of those quantities (*e. g.* that they must be integers, squares, &c.) would not improperly be said to constitute a *limited*, *conditioned*, or *restricted* problem. Or, again, seeing that the second condition does not take the form of an *equation* (*c*) the problem consists of an equation and a limitation and so might perhaps be named a *mixed* or *compound* problem.

But, however this be, the use of single terms to express those operations which are of more frequent occurrence in Algebraical investigations often enables us to save a considerable quantity of explanation. On the other hand when, for the purpose of avoiding length and tediousness, a step is taken without

(*a*) This equation occurs in the Exercise *supra* p.p. 14—15.

(*b*) The portions alluded to will be found at p.p. 272, 293, 322, 323 of vol. xlvi. of this work.

(*c*) The distinction arising from this circumstance is adverted to *supra* p. 134.

ng the process by which the ad-
made, a simple term enables us
to the process without a tiresome
on of lengthy phrases, and, at the
me, gives a greater clearness and
precision to our researches. By
example;—it is by no means un-
t to change the form of an ex-
by adding to and subtracting
the same quantity (d). So we
ter the form of an equation by
equal quantities to, or subtract-
al quantities from each side of
ation,—as, for instance, in the
solution of a quadratic. Now
ration might be termed SUPER-
N, and the words "by superposi-
ould explain the process. Of
his remark is only made with a
the convenience of young read-
t then it is often the fate of this
inquirers to be stopped and con-
the want of explanation of steps
bvious enough to the practised
atician, are yet full of difficulty
whose experience and practice
fficiently great to enable them to
pon and perceive those steps
requisite facility and prompti-

e note which introduces my (er-
ly headed) Second *Chapter on
cal Geometry* (*Mech. Mag*. vol.
245) I have alluded to the dis-
between "absolute zero" and

he terms *absolute zero* and *zero*

ccordingly to be carefully distin-
in treating of Algebraic Nomen-
In fact, without such distinc-
never could infer that a series

$0x + 0x^2 + 0x^3 + \&c.$, *in inf.*

zero *for all values of x*; and so
lty would be introduced into the
of "Indeterminate Coefficients"

ll add a remark or two on surd
ns. Let

$(x) = f_1(x) \times f_2(x) \ldots\ldots (3)$

there be *two* (and only *two*) un-
alues of x which will satisfy the
n

$$F(x) = 0$$

and suppose that *both the* values of x satisfy the equation

$$f_2(x) = 0$$

but that neither of them will satisfy the relation

$$f_1(x) = 0\,;$$

then, if there be any value of x which will make

$$f_1(x) = 0$$

that value must make

$$f_2(x) = \pm \infty$$

otherwise there would be more than two values of x capable of fulfilling (3). Now let

$$f_1(x) = 3x + \sqrt{30x - 71} - 5$$

$$f_2(x) = 3x - \sqrt{30x - 71} - 5$$

then there are only two values of x which will make $F(x)$ vanish (f); and those values also make $f_2(x)$ vanish (g), but neither of them will make $f_1(x)$ vanish; hence if

$$3x + \sqrt{30x - 71} - 5 = 0 \ldots\ldots (4)$$

then $3x - \sqrt{30x - 71} - 5 = \pm \infty \ldots (5)$

and subtracting the latter of these equations from the former, we obtain

$$2\sqrt{30x - 71} = \mp \infty \ldots\ldots\ldots (6)$$

and, substituting in (5) the value of x derived from (6) we obtain a result of the form

$$\infty = \text{a finite quantity}$$

which is absurd. Hence there is *no* value of x which will satisfy (4). Thus the doubt thrown out at p. 128 of Mr. Lund's edition of WOOD's *Algebra* is removed, and our result is in conformity with the opinion of HORNER (h).

I shall resume the subject of "Congeneric Surd Equations," at another time, but I take this opportunity of suggesting the following

Exercise. Having given,

$$x = a - r$$
$$y = b - mr$$
$$z = nr - b$$
$$w = a + r$$

prove that the ratios $a{:}b$, and $r{:}b$, may be assigned so as to make

$$x^3 + y^3 + z^3 = w^3$$

in the processes used at the places cited
).
WOOD's Algebra (Lund's ed.) p. 194, *et seq.*
e zero's must be taken to be *absolute*.

(f) For $F(x)$ is, in this case, a quadratic function of x.

(g) WOOD (Lund) p. 128.

(h) *Vide supra*, p. 136, note (p). See also Professor J. R. Young's *Algebra*, 4th ed. (Lond. 1844) pp. 130—133.

and, combining results thence deduced, show that

$$(282)^3 = (81)^3 + (85)^3 + (138)^3 + (171)^3 + (239)^3$$

With this Diophantine question I shall conclude the present paper.

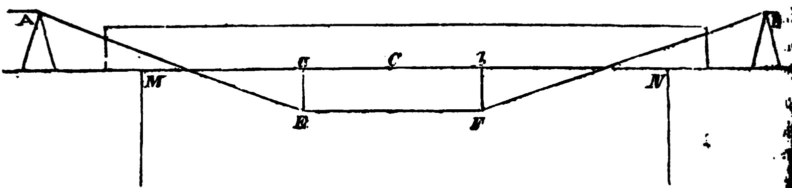
Corrections. Page 134, left hand column, equation (2), *for* + *read* −

Page 135, equation (5), *for* $\sqrt{5x} + 10$ *read* $\sqrt{5x + 10}$.

(*To be continued.*)

REMARKS ON MR. DREDGE'S PAPER ON IRON GIRDER BRIDGES (NO. 1251).

Sir,—As everything proceeding from Mr. Dredge on the subject of bridges is likely to command great attention from both practical and merely mathematical readers—I venture to request his attention to a few points in his investigation which, perhaps, he will be so good as to elucidate rather more fully, for the benefit of myself (and also, possibly, of some others of your readers). That to which I wish chiefly to call his attention, is the conclusion to which he has arrived (page 105, col. 2), viz., that the girder shown in the fig. 5 is "nine times stronger by such an arrangement of tensile bars than it would be without them."



From Mr. Dredge's description and fig., the truss-rods AEFB are perfectly unconnected with and independent of the girder or beam which is to be supported, except, I presume, by the props Ea and Fb. Assuming the point C, at which the fracture will take place, to be equally distant from E and F: and Ma = ab = bN, if the whole length of the girder (QL) be uniformly loaded (the weight on each unit $= \mu$), Mr. Dredge says, that "the moment of the superincumbent weight round C will equal $\frac{1}{9}$ L$^2\mu$." It appears to me that Mr. Dredge has not only omitted to take into account the re-action at the abutments M and N, but has made some incorrect assumptions in the following reasoning:—"Let μ be the load on each unit of L, then $\frac{2}{3}$ Lμ = the load between each of these equal spaces, or $\frac{1}{3}$ Lμ would be the resolved force on the props E and F. Hence $\frac{1}{3}$ Lμ. $\frac{1}{3}$ L $= \frac{1}{9}$ L$^2\mu$ = moment of superincumbent weight round the central point in the neutral axis, about which (in the event of rupture) the fractured ends would turn." Now the only way in which the problem can be treated, seems to me as follows:—The beam or girder is kept at rest by the following forces (all of which are supposed to remain vertical); the uniform load 2Lμ, which may be supposed collected at C, the two reactions at M and N, which we may assume each = P, and the two re-actions of the props at E and F, which we assume each = Q. This gives the equation

$$P + Q = L\mu.$$

Again, if M denote the moment of the internal elastic forces round the neutral axis through C, corresponding to Mr. Dredge's $\frac{T\, b_1\, n}{6d}(d^3 - d_1^3)$.

$$M = L\left(P + \frac{Q}{3} - \frac{L\mu}{2}\right).$$

How the second side of this equation can be got equal to $\frac{1}{9}$ L$^2\mu$, I do not see.

There is no necessary connexion between the pressure P and Q, except that their sum must equal the superincumbent load. Hence the problem must necessarily remain indeterminate.

ndependently of this, Mr. Dredge, entence quoted, appears to have l thus:—"The load on EF is

nd each prop bears half of this

erefore the moment round C is ure at F multiplied by

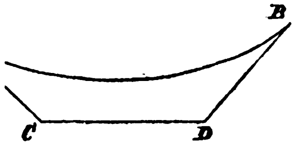
$\cdot$ EF, or $\frac{1}{3}$ Lμ $\times$ $\frac{1}{3}$ L."

load supported by each of the E and F is evidently not nearly hat on EF; for this is neglecting r the portion on aM and bN, re-actions at the abutments.

parts of the investigation I cann, from the omission of several of s in the diagrams (which I take ortunity of commending to the of the wood-engraver, as a quent source of annoyance, the n correctly all the letters of a diang of more importance than any t).

can be no doubt whatever as to n greater efficacy of independent nnected truss-rods, such as in figure, to those forming one em with the girder itself; but I ink their relative efficiency can ted in the way Mr. Dredge has d. The following questions I the liberty of putting, as some ay deserve consideration:

upposing the girder AB to be n the figure,



ot the fracture take place far n the rods AC and BD, rather either AB or CD?

ms to me evident that these rods e the first parts to give way, by g in two; and that it is to these principal care should be given, ere they are connected with the r perfectly distinct from it (ex- C and D).

f this be true, whether Mr. s conclusion that "the assist- ndered by the tensile bars is in on to their depth," is correct? By the "depth," I suppose is meant the distance of CD from AB in the last figure. In Mr. Dredge's investigation (bottom of page 103) he has altogether omitted to consider the action of the bars AE and BF in fig. 3, and has made the whole depend on the action of the lowest rod EF. Now this supposes AE and BF perfectly rigid, whereas they would be the first to break, I believe.

As I may very possibly have misunderstood Mr. Dredge's meaning in some places, perhaps he will be kind enough to set me right.

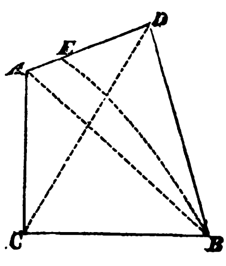
A. H.

YACHT SAILING.

Sir,—Having noticed the jib and foresail in a former number of your Magazine, I proceed to make some remarks upon the mainsail.

The management of this sail is one test of a sailor's experience. No two points of it are in precisely similar circumstances in relation to the wind, yet when once set, its position is regulated by a single rope. We may divide the action of the trapezoid mainsail into that of two jibs, the line A B being the foot of one A B D, and the leach of the other A B C, as shown in the figure.

Fig. 1.



When sailing close hauled, it appears to me that the induced current of air between the foresail and the mast, and nearly parallel to the boom, increases the pressure on the mainsail by producing a partial vacuum to leeward of it. The existence of this draught from the foresail is often made manifest when a cutter is laying to with the foresheet hauled to weather.

Fig. 2.

The sails will then be in the position indicated in fig. 2, and a watchful eye will observe that the mainsail will then begin to shake near the tack, doubtless on account of the wind being brought more ahead by the deflection from the backed foresail. Again, the great loss of way consequent upon hauling up the maintack, may be attributed to the effective pressure being diminished by the free ingress to this vacuum then afforded to the wind; and I am convinced that it is nothing but a similar freedom from lee pressure, caused by the draught from the mainsail, which causes mizens to stand so well.

Those who assent to this idea will agree with me in approving of mainsails high in the hoist and short in the foot; and consequently in preferring (after a certain tonnage) the fore-and-aft schooner rig to that of a large cutter, whose gaff is so unmanageable as often to be three points to leeward when the mainboom is on the taffrail.

The two curves in the mainsail most objectionable from their convexity, are in planes perpendicular to that of the paper and passing through the points A B and C D, fig. 1. The weight of the boom and the tension of the sheet are the principal forces tending to lessen the first curve, while the second cannot be much reduced without a great strain upon the peak-halliards. The curvature along A B is lessened when the weight on the foot of the sail is increased; and hence we see one reason why a sail which would "*belly*" at full hoist may stand well when a couple of reefs are in. As for the second curve, it is made to disappear by using a sprit; and we may often see Thames barges, the fl whose mainsails would do credi rig of a yacht. The curved dot fig. 1, is abaft the most efficien the area of a mainsail, the part nearly coinciding with the cut of mudian mainsail of higher hoist those "*appogiaturas*," gaffto shall only say, that I leave then for, with the exception of the an sheet to be paid out to a mainsa is no more fertile subject for sail pute than the cut of a gafftopsai

I am, yours, &c.

JOHN MACGI

Battersea, August 7, 1847.

P. S. Corrections in the former nication on this subject. Read vangs, *leach* for *leack*, and *aback* f

THE "QUESTIONS ON FRICTION"

Sir,—The questions asked by respondent who signs himself " stant Reader," are easily a though not exactly in the way them. There is no relation exi tween rolling and sliding frict former depending on the natu axles, the latter on that of th and rails. It is, however, not to calculate what would be the per ton in the case of sliding fr

Let ϕ be the uniting angle c ance between the wheels and (or that angle at which an inclin must be elevated, so as just to c carriages to slide down); then the weight of the carriages, W tractive force necessary on a le which must be exerted in order the carriages just begin to slide.

$\therefore$ 2240. $\times$ tan ϕ = traction in per ton.

In the case of iron sliding $\phi = 23° 45'$ and 2240 tan $\phi = 197$

Hence the traction is 197 po ton.

If the rails were wet, the tracti be probably not much more than amount. So that in round nun may say that the friction of s about 20 times that of rolling.

In answer to question 2nd., state, that the number of whee not affect the question; becau this answers 3rd. question, the depends on the pressure alo scarcely, if at all, on the amoun

...ace and velocity of motion, the being not too close to that ...oduces abrasion of the rubbing

...wer to the 4th question: The ...m of the locomotive would be ...edily destroyed when the wheels ...volving the reverse way than ...rest; for beside that the mo... is working against friction, it is ...ing against the engine. The ...ount of resistance would only be ...ed from experiment, as it is ... And we are not entitled to as... t it would be equivalent to the ...he resistance due to the motion ...heels, if there were no sliding, ...the sliding, if there were no ...f the wheels.

...clusion, I may state, that some ...eriments on the resistance op... trains, both with the breaks on ...s still a desideratum.

I am, Sir, yours truly,

...da.

...GSS OF ELECTRIC CLOCKS AT SEA.

...he great importance of a good ...er at *sea*, and the advantages the ... *clock*" seems to possess over ...chronometers, has led me to think, ... could be adapted to ship-use, a ...l would result.

...ectric clock, besides regularity of ...ssesses the additional advantage of ... for an indefinite period without ...ce or attention, and by the use of ...*ater* as the exciting liquid, I think ... difficulty, that of obtaining a bat...*ng continued action*, might be re...

...ct, however, of a ship's not being ...*sea* water, may be found to be an ... In that case, might not the ...*battery*," the "mud-battery," or ...rcolating galvanic trough," with ...odifications, be successfully em...

...not leisure to satisfy myself of the ...ility of these ideas by experiment, ...it them to the readers of the *Me... Magazine*, hoping that they may ...me one to investigate the subject, ...results may be obtained practically

I am, Sir, yours, &c.,

MECHANICUS.

...tle-upon-Tyne,
...ust 2, 1847.

THE ELECTRIC TELEGRAPH VOCABULARY AND THE PHONETIC SYSTEM.

Sir,—If you consider the following suggestions of improvement in the vocabulary used in the electric telegraph of any value, I shall be glad to see them inserted in your journal.

The improvement I am about to speak of is the substitution of the phonetic mode of spelling in the place of the old common method.

The phonetic system of writing possesses many advantages over the old hetrotypic method of spelling words: such as, an unvarying representation of the sounds of the human voice by the characters representing them — a correct method of spelling words according to their pronunciation—a saving of time in writing—and, in consequence, a less number of characters used to represent words.

I have now lying before me an extract out of Sacspear (Shakespeare) in the play Henry VIII., act 3, scene 2, containing 35 lines, written in both systems. The phonetic method is written with 180 letters less than the old system is written with.

If it is desirable to attain the highest state of perfection, I think the phonetic system should be adopted, especially as there is no further inconvenience attending the use of it than learning a new alphabet.

I will give a few samples of spelling in the old system for your inspection. The letters which are here *united* in the spelling of the words are such as are represented by *one* character in the new method, (viz.,) h-a-ve, f-a-m-es, ch-ee-se, bea-u-t-y, vic-t-ual-s, sh-ee-p, sh-ar-pe, mar-r-i-a-ge, &c., &c.

I think the foregoing is sufficient to illustrate my meaning; and I think it must be obvious that it would take less time to set Mr. Bain's machine to work with the phonetic system than it would with the hetrotypic.

I am, Sir, yours, &c.,

T. T. J.

Stoke-upon-Trent, August 11, 1847.

[Our correspondent has the merit of discovering one case in which the phonetic system might really be useful. As a general system it is one of the most absurd ever propounded.—ED. M. M.]

CRADDOCK'S HIGH-PRESSURE, EXPANSION, AND CONDENSING STEAM-ENGINE.

(Continued from p. 125.)

Fig. 18.

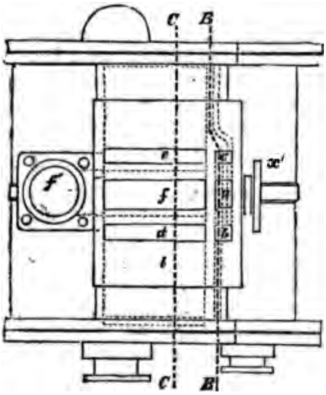


Fig. 16.

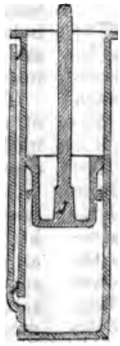


Fig. 19.

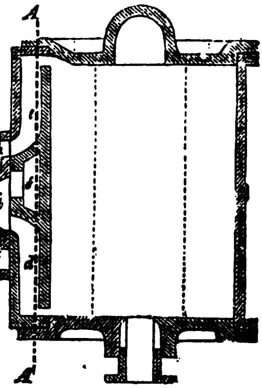


Fig. 15.

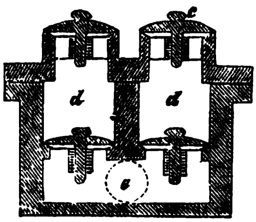


Fig. 14.

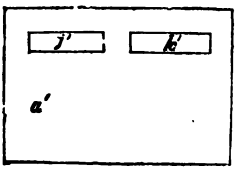


Fig. 22.

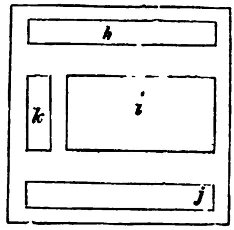


Fig. 17.

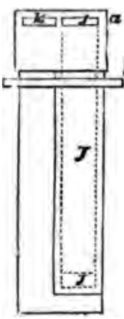


Fig. 21.

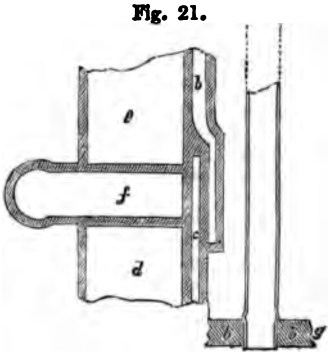
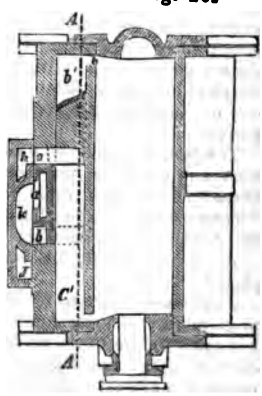


Fig. 20.



The Air Pump.

In figure 11* is the air-pump which is worked by means of the connecting-rod h^1, before mentioned as being carried from the cross-head *d* of the connecting rod of the small high-pressure cylinder. The pump is double acting, and so constructed, that all the valves are at the top of the pump and kept constantly sealed by water, so that the external air can have no access into the interior of the pump. The details of this

* See last Number.

construction are shown in figures 14, 15, 16, 17. In figure 15 the front part is supposed to be removed. In figure 14 a^1 is a plate which screws on to the face *a* of figure 7, having two parts j^1 and k^1, which correspond with the apertures *j* and *k*; *b* is a flange cast on the pump barrel which supports a cistern *g*, which rises above the level of the valves and gland, and is kept constantly filled by water discharged from the pump, so that no air can find its way into the pump: *d*, *d* are the receiving valves; *e* is a pipe which leads from the condenser into the chamber underneath these valves, and is common to both, though the valves themselves are divided by a bridge *g*; *c c* are the delivery valves, the seats of which are screwed on the bridge *g* and flanges *i i*. The pump when in use is always filled with water at the bottom to a height a little way above the opening into the passage *j*, so that the piston *l* in its descent always dips into the water before it comes to the end of its stroke, and drives that water with the air before it up the passage *j*, whence they are discharged through the port j^1. And a like effect is produced at top by making the lid of the cylinder to descend a little way below the port k^1, and cutting out a passage in it to the port, whereby the lid meets the water on the top of the piston before it has quite completed its stroke, and drives the water and air before it through the port.

The Steam Valves.

The construction of these valves is represented in figures 18, 19, 20, 21, 22. Figure 18 is a plan of the steam ports; *a* is the port which communicates with the boiler through the induction pipe a^1; *b* and *c* are the ports which lead to the small or high-pressure cylinder, the former (*b*) communicating with it at the top, and the latter (*c*) at the bottom; *d* and *e* are the ports leading to the large or low-pressure cylinder, *d* leading to the bottom of the cylinder, and *e* to the top; *f* is the exhaust port, and f^1 the exhaust pipe. Figure 19 is a section on the line B of figure 1. Figure 20 is a section on the line C, and figure 21 is a section on the line A A of figure 3. Fgure 22 is a plan of the face of the valve. When the valve is in the position shown in figure 3, the steam passes from the bottom of the small cylinder through the passage *h* into the top of the large cylinder, while at the same time, the steam from the bottom of the large cylinder flows through *f* to the condenser. Figure 19 shows how the steam passes from the upper port *c* of the small cylinder (through the passage c^1 c^1) to the lower port *d* of the large cylinder. When the port *h* (figure 22) is over the ports *e* and *c*, the steam passes from the bottom of the small cylinder to the top of the large one, while the port *j* rests.

(*To be continued.*)

THE GUTTA PERCHA PATENTS.—NO. VIII.*

Fig. 2^a.

Fig. 1.

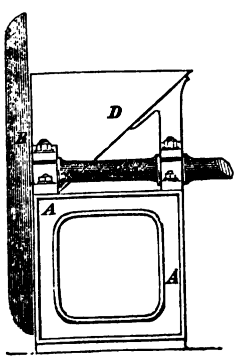
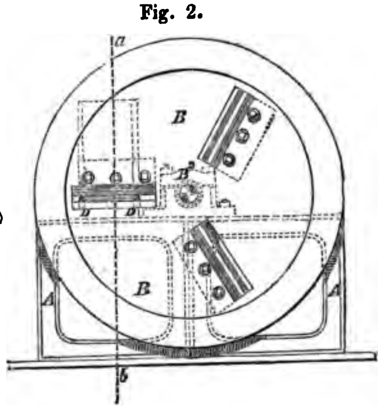


Fig. 2.



CHARLES HANCOCK, *of Grosvenor-place, Artist, for "Certain Improvements in the Preparation of Gutta Percha, and in the Application thereof, alone and in combination with other Materials, to Manufacturing Purposes, which Improvements are also Applicable to other Substances."* Patent dated Feb. 10, 1847; Specification enrolled August 10, 1847.

The improvements embraced by this patent have relation, *Firstly*—To the methods and machinery employed for preparing gutta percha for manufacturing purposes. In the specifications of former letters patent granted

* For specification of former patents, see *Mech. Mag.*, Nos. 1180, 1181, 1182, 1183—1185—1200—1232, 1233.

to me, touching the preparation and application of the said substance, I have directed that, for the purpose of cleansing crude gutta percha from the impurities which it contains, in the state in which it is ordinarily imported into this country, it should be first reduced into small pieces, by means of saws, knives, choppers, and other suitable instruments; and I have also therein observed that the cutting of lumps of gutta percha will be very much facilitated by first steeping them in hot water until they are softened. Now, I have since found that, by the employment of a machine of the description represented in figs. 1 and 2 of the annexed drawings, the crude gutta percha may be cut with the utmost facility into very thin slices, without any previous steeping in hot water; and that the washing, purifying, and softening of the material are best effected by passing it, after it has been so cut into slices, through the machinery represented in fig. 3 of the said drawings. The said machine and machinery are constructed and worked as follows:

Fig. 1 is a side elevation of the slicing machine; fig. 2, a front elevation of it; and fig. 2^{a} a sectional elevation A on the line $a\ b$ of fig. 2. A A represents the framework; B is a circular iron plate, of about five feet diameter, in which are three slots, into which are inserted three radial knives, in a similar manner to the irons of an ordinary plane or spoke-shave. B^2 is a shaft, to the end of which the plate B is attached, and by means of which it is made to revolve at any desired velocity, motion being communicated to the shaft from a steam engine, or any other convenient first mover, through the medium of gearing or drums. D is an inclined shoot, down which the lumps of crude gutta percha are dropped against the knives of the revolving plate B, by which they are cut into slices of a thickness corresponding to the degree of projection given to the knives. The slices are afterwards collected, and put into a vessel filled with hot water, where they are left to soak till they feel soft and pliable to the touch.

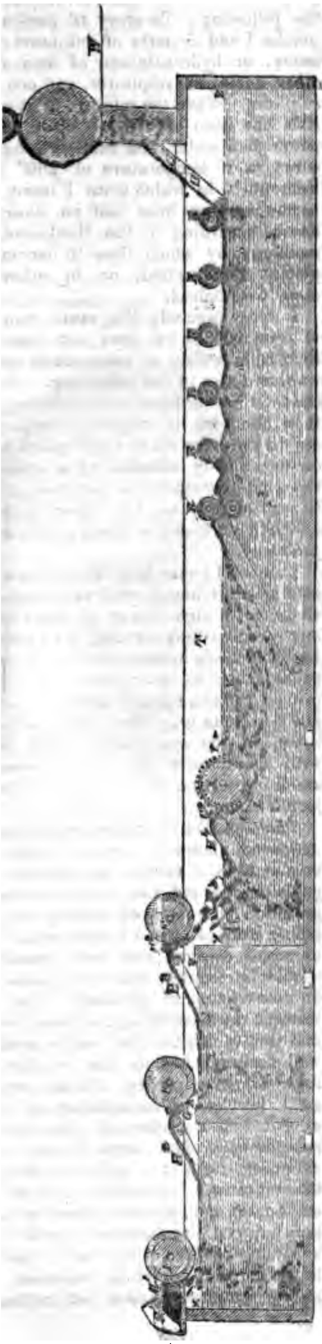
Instead of using a circular revolving cutter, such as has been just described, a vertical cutter, with rising and falling motion, may be used, and the other parts of the machine may be modified accordingly; but I prefer the former, as being more simple and equally efficient.

The knives are represented in the drawings as being straight; but where the gutta percha to be cut happens to be of a more than usually hard or intractable quality, I find it advantageous to substitute knives of a curved or reaping-hook form, on account of their more gradual mode of action.

Fig. 3 is a longitudinal elevation
tion of the machinery through wh
gutta percha is passed, after havi
steeped as aforesaid in the hot-wate
till it has become soft and pliable
touch. T is a large tank, which is
into three compartments, t^1, t^2, t^3, o
t^1 and t^2 are filled with water to th
of the line $x\ y$, and t^3 with water
height of the line $x\ z$. F^1, F^2, F^3 a
breakers or rollers, with serrated bl
serted in them in a direction parallel
length, which are mounted transvers
the tank T, and revolve clear of th
In front of each of these breakers th
pair of fluted feeding-rollers, G^1,
H^1 is a funnel-shaped shoot, throug
the softened pieces of gutta perch
being taken from the hot-water ves
passed to the feeding-rollers (G^1)
first breaker F^1. H^2 is an inclined
web, which revolves on two rollers
dips at its lower end into the wate
at its upper end it comes opposite th
between the feeding-rollers of the
F^2. H^3 is a second inclined endle
which bears the same relation to th
breaker F^3 as H^2 to F^2. K is a
cylinder, with radial blades (similar
used in paper-mills for the conver
rags into pulp), which is mounted
versely over the third compartment
tank, but at a lower elevation th
breakers F^1, F^2, F^3, so that one ha
shall always be immersed in the w
that compartment. L L are edge-pl
fixed that the blades of the cylinder
in revolving, come into such close p
ism with them, as to produce, b
approximate conjunction, a scissor-li
of action on any matters which ma
in contact with them. The mincing c
K has, like the breakers F^1, F^2,
endless web (H^4), and a pair of f
rollers (G^4) attached to it. M is a
agitator, which is wholly immersed
water of the compartment t^3. N is a
ing endless web, which stretches
inclined direction athwart the whole
of the water in t^3, and subdivides (as i
the compartment t^3 into two divisions.
R R, are a series of pairs of rollers, m
transversely over the after part of th
partment t^3, at such an elevation th
under rollers revolve under the wate
the upper just free of it. S S are a
of tables or benches, placed betwe
pairs of rollers, for the purpose of supp
the gutta percha in its passage from
the other.

The action of this machinery, so fa
has been thus described, is as follows:
The feeding-rollers G^1, G^2, G^3, G

Fig. 3.



carrying rollers of the endless webs H^2, H^3, and H^4, and the rollers R R, are all made to revolve in a forward direction, or from left to right of the machine, as represented in the drawing, fig. 3, while the breakers F^1, F^2, F^3, the mincing-cylinder K, and agitator M are made to revolve in the opposite direction. (The mechanical contrivances by which those movements are effected are omitted from the figure, as being all of a common and well-understood description.) The breakers and mincing-cylinder should revolve at the rate of from 600 to 800 revolutions a minute, but the feeding-rollers and endless webs need not move faster than at about a sixth of that rate. The first series of rollers R R should revolve at the rate of from fifteen to twenty revolutions per minute, and the others may be made to exert a drawing or stretching effect on the materials passed between them, by causing one, two, or more of the last pairs in the series to revolve at a greater velocity than the preceding ones. As the crude gutta percha is presented by the feeding-rollers G^1 to the action of the first breaker F^1, it is broken up into shreds or fragments, and considerable quantities of earthy and other extraneous matters are beaten out of and disengaged from it, the whole falling in a mingled mass into the water beneath (that, viz., which is contained in the compartment t^1 of the tank,) where the different materials assort themselves according to their specific gravities. Such pieces as consist of pure gutta percha, or in which gutta percha predominates, float on the surface of the water, while most of the earthy and other extraneous matters sink to the bottom. The revolving endless web H^2 then draws towards it the floating gutta percha, and carries it upwards to the second set of feeding-rollers G^2, mounted over the second compartment t^2 of the tank, from which rollers it is delivered to the second breaker F^2, to undergo a repetition of the process which has been just described, in order to its being further disentangled and purified. From the surface of the water in the compartment t^2 the gutta percha is carried up the inclined endless web H^3 to the rollers G^3, which deliver it to the third breaker F^3 over the compartment t^3, by which it is a third time broken up, in order to any remaining impurities being separated from it. The inclined endless web H^4 next carries it forward to the rollers G^4, which present it to the revolving cylinder K, by the blades of which it is cut or minced into a multitude of very thin slivers, which, as they fall into the water in t^3, are thrown forward in the direction of the agitator M. As this agitator revolves in a direction opposite to that in which the floating mass of

gutta percha is moving, it forces the gutta percha down into the water, and to take a circuitous course through it towards the large endless web N, whereby it is washed free from any dirt which may have collected upon it in passing through the preceding operations. By the endless web N, the gutta percha is next moved onwards to the series of rollers R R, R R; and from the last pair of the series, the gutta percha is raised by an endless revolving web O to a pair of metal pressing and finishing rollers Y^1 Y^2, which are set by adjusting screws to a distance from one another equal to the thickness of the sheet or band into which it is now desired that the gutta percha should be compressed. After passing through between Y^1 Y^2, the sheet or band is carried back over the topmost of these rollers (Y^2), and then over the wooden drum U, to be wound on a taking-up roller V. As it is turning back over the roller Y^2, a sheet of cloth, or any other material suitable for joining with it, may be led in, as shown at W, and, by being pressed in conjunction with it between Y^2 and the drum U, it will be firmly united to it.

The water in all the compartments of the tank T should be used cold. When the crude gutta percha happens to have a fetid smell, as is not unfrequently the case, I mix with the water a solution of common soda, or of chloride of lime, as directed in the specification of former letters patent granted to me of date the 9th of November, 1846.

The whole of the improved machinery described under this head of my specification will be found also applicable to the cleansing, purifying, and otherwise preparing of bottle caoutchouc and of jintawan in its crude state.

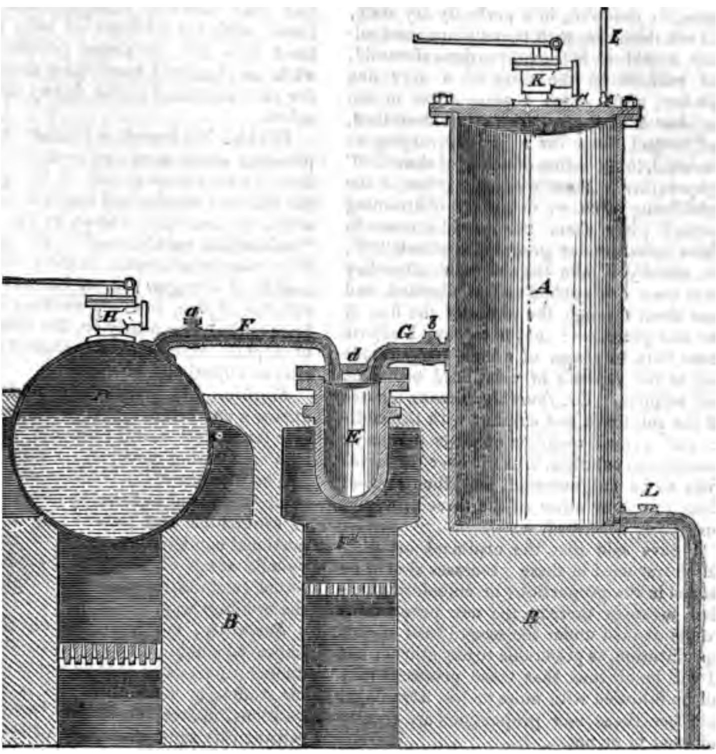
Secondly, My invention consists in certain improvements or processes, previously patented by me for sulphuretting of gutta percha (since called metallo-thiönising), and in the application of these improvements to the sulphuretting of caoutchouc and jintawan. In the specification last hereinbefore cited, I have recommended that the sulphuretting of the gutta percha should be effected by means of sulphurets, such as orpiment or liver of sulphur in preference to sulphur itself; and I have there stated that though a portion of sulphur may be used in place of an equal portion of sulphuret, yet that I consider the use of sulphur to be altogether objectionable because of its offensive smell and tendency to efflorescence. I have since, however, ascertained, that if a very minute portion of sulphur be used along with a sulphuret, a better result is obtained from a combination of the two than from either substance alone proportions which I find best in prac the following: To every 48 parts o percha I add 6 parts of sulphuret (mony, or hydrosulphate of lime, o other analogous sulphuret, and one sulphur. When the mixture of thes rials has been effected, I place th pound in a boiler, and raise it (unde sure) to a temperature of 260° t Fahrenheit, in which state I leave period varying from half an hour hours, according to the thickness materials, by which time it becom pletely sulphuretted, or in other metallo-thiönised.

I apply precisely the same comb of materials, as has been just descri the sulphuretting of caoutchouc and wan, and also in the same way. As chouc is now ordinarily sulphurized, than one part in weight of sulphu quired for every six or eight parts of chouc; but by substituting a sulph the extent hereinbefore directed, th tity of sulphur may be reduced to l a fiftieth part, and a much better a produced.

I am well aware that the process jecting caoutchouc, combined with alone, to a high degree of heat, ar ous modifications thereof, have bee used and made known, first in Ame subsequently in this country; but t proved process, which I have herein s and lay claim to, differs essentially these, in the caoutchouc being co with a sulphuret and only an exce small proportion of sulphur, and th jected to heat.

Thirdly, My invention consists in improved modes or means of effec combination of sulphur and sulphur gutta percha, and also with caoutch jintawan. In the specification last before cited of former letters patent to me, I directed that such comb should be effected while the gutta or caoutchouc, or jintawan, were through the masticating machine; bu find that it may be more readily and well accomplished in one or other four following modes: First I exp gutta percha, or caoutchouc, or ji after it has been cleansed and puri reduced to a sheet state, to the co action of steam of a high temperat the vapours of orpiment (or other sulphuret) and sulphur (mixed in t portions last hereinbefore specified apparatus of the description repres fig. 4 of the engravings annexed. strong metallic chamber set in the

Fig. 4.



, into which the materials to be :ed are placed. C is a steam tight loor, which is secured to the top hamber by screw bolts, so that unscrewed and removed as occa- require. D is a common high- team boiler. E is a strong metal rhich the orpiment, or other sul- id sulphur are placed. *d* a lid or ugh which the materials are in- and E′ a fire-place by which the ted. F is a pipe leading from the o the head of the pot E; and *a* r which it is opened and closed. pe leading from the top of the pot :hamber A, and *b* a cock by which ed and closed. H is a safety valve o the boiler, and K a safety valve o the chamber A. I is a thermo- indicate the temperature. The operating with the apparatus is : The boiler furnace is first id when the safety valve indicates :h to a temperature of 280° Fahr., the other furnace is lighted which is to volatilize the orpiment and sulphur. The cocks *a* and *b* are then opened, and the steam allowed to pass off through the pipes F and G, and head of the pot E, into the chamber A, containing the material, in order that they may be thoroughly heated before being sulphuretted. After a short time fumes from the orpiment and sulphur begin to ascend and mingle with the steam. In this state I leave matters for a period varying from half an hour to two hours, according to the thickness of the materials operated upon. I then close, by means of the cock *b*, the passage to the chamber A, draw or damp the fires, raise the safety valve K, and when the chamber A has been cleared of vapours, remove the sulphuretted materials. The safety valve H is kept all the time the sulphuretting process is going on, at a little higher pressure than the safety valve K, in order that there may be a current in the direction of the chamber A. L is a cock by which the condensed water, which accu-

mulates in the chamber A, is drawn off. Or, *secondly*, I take the gutta percha, caoutchouc, or jintawan, in a perfectly dry state, and rub them over with the sulphuret and sulphur, combined in the proportions aforesaid, and reduced to the state of a very fine powder; after which I place them in the chamber A of the apparatus last described, and subject them for a period, varying as aforesaid, to the action of steam, of about 280° temperature, without making any use of the volatilizing furnace: or instead of steaming them, I place them for the like space in water heated under pressure to about 280°. Or, *thirdly*, I take the materials, after they have been dry rubbed as last directed, and pass them through the whole of the first of the said processes; that is to say, I expose them both to steam of a high temperature and to the vapours of volatilized orpiment and sulphur. Or, *fourthly*, I make a paste of the sulphuret and sulphur with the addition of a small quantity of gutta percha or caoutchouc solution, brush it over the materials to be sulphuretted, and then subject them to one or other of the three processes previously described.

I have said that the orpiment or other sulphuret used in these processes should be mixed in the proportions hereinbefore specified, meaning thereby the new proportions recommended under the second head of this specification, as preferable to any others; but it will be obvious that these processes may all be followed with more or less advantage, whether these new proportions are strictly adhered to or not.

Fourthly. My invention consists in the following means or methods of improving the quality of gutta percha, both in a sulphuretted (metallo-thiönised) and unsulphuretted state, and in the application of the same to caoutchouc and jintawan in the like sulphuretted and unsulphuretted states. I either expose for a minute or two the materials to the action of binoxide of nitrogen gas, obtained by the usual method of dissolving a metal, such as zinc, copper, or mercury in nitric acid, or I immerse it in a boiling and concentrated solution of chloride of zinc, from a period varying from one to five minutes, according to the strength of the solution. And in either case, I afterwards wash the materials well in some alkaline solution, or in soft water. The materials may have the binoxide of nitrogen gas applied to them, either by putting them into the acid, while the metal is in the course of being dissolved, and the gas evolved, or by introducing them into a chamber in which the gas has been collected for the purpose. Gutta percha, which has been thus treated, and whether sulphuretted or unsulphuretted, becomes exceedingly smooth to the and of a lustre approaching to meta also does common unsulphuretted chouc, with the addition of being freed from that stickiness peculiar while sulphuretted caoutchouc acqu der such treatment all the downy sof velvet.

Fifthly. My invention consists in plication of the means or methods la cified to the improvement of the qu the ordinary sulphurized caoutchouc, which is commonly known by the n "vulcanized caoutchouc." By su it in manner aforesaid, to the actio noxide of nitrogen gas, or immersi chloride of zinc, and then washing it loses entirely, or nearly so, the stron of sulphur, which makes the use of it sent so objectionable.

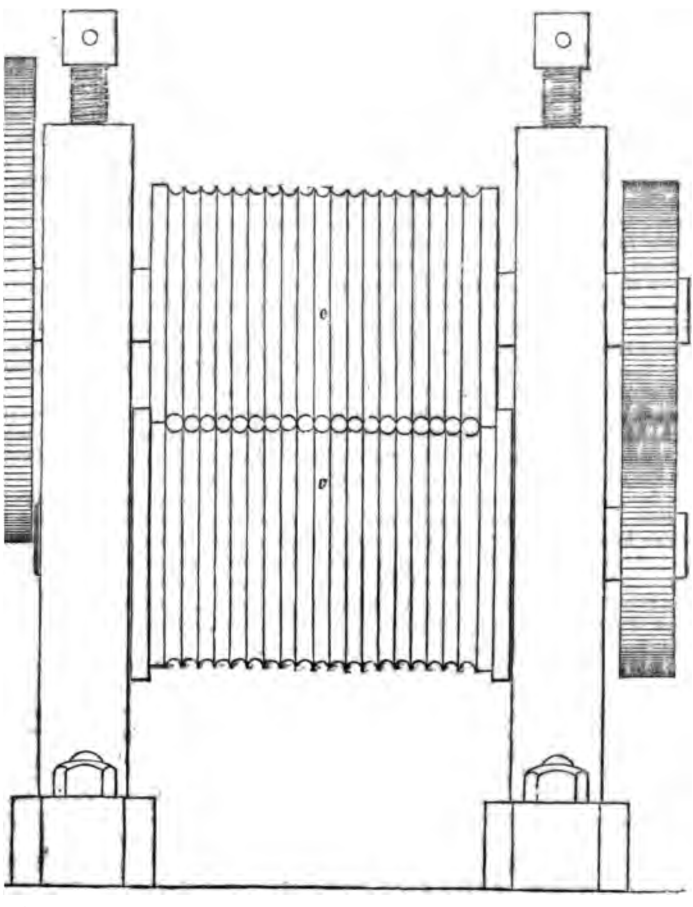
Sixthly. My invention consists ducing a new compound of gutta perc able for several useful purposes, by in a masticating machine, six parts percha with one of the chloride of zin mentioned; and in forming new com of caoutchouc and jintawan by a li portional combination. All of thes pounds admit of being afterwards retted (metallo-thiönised) or sulphu the ordinary way.

Seventhly, my invention consist improved combination of materials ducing a porous or spongy gutta pe for stuffing or forming the beds of cushions, mattresses, saddles, horse- railway carriage-buffers, and other li cles, similar to that described in hereinbefore cited specification; application of the said improved co tion of materials to the rendering of chouc and jintawan similarly por spongy. I take 48 parts of gutta pe caoutchouc, or jintawan (moistened, very soft and light product is desire oil of turpentine, or naphtha, or bisu of carbon, or other proper solvent), s of hydrosulphuret of lime, or sulph antimony, or any other analogous sul ten parts of carbonate of ammonia, bonate of lime, or other substance w either volatile or capable of yielding tile product, and one part of sulp mix the whole of these materials in a cator together, and then subject the high degree of heat, observing the conditions in respect thereof as are se in the specification last hereinbefore except only that the heat may be with advantage several degrees high to from 260° to 300°.

Eighthly. My invention consists application of the various means a

ɔf improving the quality of gutta described under the third and fourth 'this specification, to the improvement ɿuality of articles manufactured of ʳ gutta percha, after they have been .factured; and in the application also ıme means and methods to the im- ɪnt of manufactured articles of caout- : jintawan, or of any compound or f which gutta percha, caoutchouc, or may form a part. Among the rcha and caoutchouc articles which nost improved in quality and appear- these processes (whether applied to erial before it is made up or after- ıre—those waterproof fabrics known in commerce by the name of "double and single textures," boots, shoes, galoshes, gaiters, braces, belts, bands, bandages, capes, cushions, life-preservers, (flexible) bottles, bags, tubes, hose, flasks, cases, sheaths, holsters, cartouch-boxes, knapsacks, caps, helmets, hats, cups, bowls and other vessels of capacity, hammercloths, gig-aprons, printers' blanketting, covers for rollers employed in pressing and finishing soft goods, cotton-spinning rollers, backs of cards for carding wool, backs of brushes, washers, flute-key stops, piano-hammers, bottle-stoppers, capsules, cord, thread, string, rings, paper-holders, springs, trusses, trouser and other straps, &c., &c.

Fig. 5.



y, [My invention consists in pro- ʳ the combination of gutta percha, caoutchouc, and jintawan, or with other materials, a fabric of a permanent lustre

resembling that of japanned goods; and by giving the like lustre to articles made of any of these materials in a sulphuretted or metallo-thiönised state. I take the gutta percha, caoutchouc, or jintawan, after it has been sulphuretted, or metallo-thiönised, any of the processes before described, or by by any other known process, and thereby enabled to bear a high degree of heat—and either before or after it has been made up into an article of use—and brush it over with a solution of resin in boiling oil. I then place the article from two to five hours in a chamber heated to from 75° to 100° Fahrenheit, and afterwards polish it by the means and in the manner usually adopted by japanners. In some instances I mix colouring matters with the japanning materials, which I apply by blocks, cylinders, or rollers, in the usual way of floor-cloth printing.

Tenthly, and lastly, my invention consists of an improved machine, or apparatus, for cutting gutta percha into strips or ribands, and manufacturing it into thread or cord of any required shape. A front elevation of as much of the machine as is necessary to an understanding of its construction is given in fig. 5. C C are two grooved rollers made of steel or iron, which are mounted in a suitable framework. The grooves of each roller are semicircular, so that when the grooves of one roller are brought opposite to those of the other, they form together a series of circular holes. The projecting divisions between the grooves are made with knife-edges, so as to divide readily any sheet or mass of gutta percha which may be presented to them. The under roller is flanged at both ends, and the two ends of the upper roller are made to fit inside of these flanges in order to keep the cutting edges from shifting or being damaged. To cut thin sheets of gutta percha with this machine into strips or ribands, the material is passed through it cold, and the cutting edges only brought into operation. To make round thread or cord by means of it: either a sheet of gutta percha, of a thickness equal to the diameter of the holes of the machine, is passed through it, at a temperature of about 200° Fahrenheit (by supplying the material from a feeding-chamber heated to that degree by steam or otherwise), and the threads or cords after coming from the machine are received into a tank of cold water, from which they are led away to, and wound on, reels or drums conveniently placed for the purpose: or the gutta percha is employed in a plastic state, and passed towards the machine under a gauge, after the manner commonly followed in the caoutchouc and gutta percha manufactures.

Should it be desired to produce cc half round, or semicircular form, away the under roller, and substitu a plain roller. Or should cord of neither circular nor semicircular, but triangular, hexagonal, or of any ot gular form, be required, I dismou cylinders, and substitute two others in such manner as to produce the figure.

And having now described the n my said invention, and in what mar same is to be performed, I declare improvements which I claim, as co in the said invention, are as follows

First, I claim the preparation c percha for manufacturing purposes, b of the machines or machinery repres figs. 1, 2, 2^a, and 3 of the drawings and hereinbefore described; that is in so far as regards the peculiar ad and order of sequence of the part said machinery, and general arra and combination thereof; but withou claim to any of the parts of which machine or machinery consists, sir separately considered.

Second, I claim the new combin materials for sulphuretting or meta nising gutta percha, specified un second head of this specification.

Third, I claim the several new of combining sulphur and sulphur gutta percha, described under the th of this specification; and the a represented in fig. 4 of the annexe ings, in so far as it forms an adjunct methods.

Fourth, I claim the employmen noxide of nitrogen and chloride of the purpose of improving the quality percha, as before described.

Fifth, I claim the application of l of nitrogen and chloride of zinc to provement of the ordinary sulphu vulcanized caoutchouc, as before de

Sixth, I claim the new compo gutta percha, caoutchouc, and jintaw cified under the sixth head of this s tion.

Seventh, I claim the improved nation of materials for producing p spongy gutta percha, caoutchouc, tawan, described under the seventh this specification.

Eighth, I claim the application various processes described under t and fourth heads of this specificatio improvement of articles of gutta per manufactured state, after they have manufactured, as before exemplified

Ninth, I claim the mode of gi sulphuretted or metallo-thiönised gu

pan-like lustre, as before described, applied before or after the making the same into articles of use.

I claim the improved machine or for cutting gutta percha into ribbands, and manufacturing it into cord, before described.

Eleventh, I claim the application of of the said improvements to caoutchouc and jintawan (in so far as such application has not been already claimed), to the fore pointed out and explained.

R OF SPECIFICATIONS OF PATENTS VENTIONS. FROM THE PERIOD THE PRACTICE OF ENROLMENT NCED TO THE PRESENT TIME.— TUED FROM P. 143.

Reports of the Deputy-Keeper of the ic Records (Sir Francis Palgrave).]

THE CALENDAR.

two dates annexed to each entry, the date of the patent, and the second that lment of the specification.]

loorn, of Barford, (Wilts): of a new or engine for sowing all sorts of grain in drills or rows, which will lant any number of drills or rows e to thirteen or upwards (accorde width of the machine), at one any distance from each other, at ı, and with any quantity of corn or each drill or row required or necessary; and which machine or adapted to use in all kinds of land, ery possible different mode of culor tillage, and by the use of which bour and expense in sowing, and d corn will be saved, as a man with e drawn by two horses only will t acres of land or upwards in one with much less seed corn than by ıon way of broadcast sowing. Cl. R, . 22, No. 3. Aug. 27, 29 Geo. 3; er 26, 1789.

r Taylor, of Southampton, blocknd *William Collins*, of the parish of y, Lambeth, engine maker: of a provement in the construction of the chambers, pistons, and boxes o belonging, so as to prevent their oked with gravel, sand, and filth, board, and for raising water with er than those now in use. Cl. R., 3, p. 22, No. 1, September 19, 29 October 15, 1789.

'empleman, of Salisbury, gunmaker: ention for making locks to discharge arrel guns and pistols by means of ger only, without the possibility of ng both barrels at the same instant, eby the one may be discharged in immediate succession to or at any distant period from the other. Cl. R., 29 Geo. 3, p. 23, No. 1. November 6, 1789; December 1, 1789.

Stephen Hooper, of Margate, gent.: of certain new-constructed machinery for regulating the power and motion of wind and other mills, as also the process of grinding and dressing therein, and for regulating all other machinery where the first motion is unequal. Cl. R., 29 Geo. 3, p. 24, No. 13. October 29, 30 Geo. 3; November 23, 1789.

Charles Smith, of Northampton, lace manufacturer: of an invention whereof the specifier has become possessed, and which is new in this kingdom, being a machine for the making of thread used in the manufacturing of bone lace, commonly called Mechlin Long Dozen, and Bell. Cl. R., 29 Geo. 3, p. 30, No. 13. May 9, 29 Geo. 3; May 21, 1789.

Edmund Cartwright, of Doncaster, clerk: of new invented machinery for the breaking, combing, heckling, preparing, spinning, sizing, dressing, and winding upon the pin, wool, tow, hemp, flax, and cotton. Cl. R., 29 Geo. 3, p. 32, No. 4. August 3, 29 Geo. 3; August 22, 1789.

John Wilkinson, of Broseley, ironmaster: of an improvement in the method of making cannon, or any other piece of ordnance made of metal, together with its shot, shell, marrow, so contrived as to give a more certain direction to the mark intended, than any other that has been hitherto in use. Cl. R., 29 Geo. 3, p. 32, No. 3. July 30, 29 Geo. 3; August 14, 1789.

Thomas Rowntree, of Surrey-street, of Christ Church (Surrey), engine maker: of "a new improvement in the construction of water closets, and which may be applicable to other useful purposes." Being a portable water closet, to which may be applied the specifier's "Circular Sliding Valve," which has the properties of both a valve and cock. Cl. R., 30 Geo. 3, p. 1, No. 18. Dec. 8, 30 Geo. 3; January 2, 1790.

John Baynes, of the Precinct of Bridewell, London, wharfinger: of an improvement in the construction of soup ladles, tureens, gravy spoons, ladles, and skimmers, for the more easily separating off mixed fluids of different densities, where one floats upon the surface of another, such as fat on the surface of soup, cream upon the surface of milk, and other chemical and philosophical operations. Cl. R., 30 Geo. 3, p. 1, No. 17. Dec. 8, 30 Geo. 3; Jan. 5, 1790.

George Godfry, of Tufton-street, Westminster, organ builder: of a new invented tamborine, tabor, or drum and pipe, which may be annexed or joined in or to barrel

organs and musical instruments, and of a method of building such barrel organs and musical instruments for the same, so as to beat and play the said tamborine, tabor, or drum and pipe therewith at pleasure. Cl. R., 30 Geo. 3, p. 1, No. 16. Dec. 8, 30 Geo. 3; January 7, 30 Geo. 3, 1790.

John Maxwell, of Brook-street, Holborn, buckle maker: of an invention of spring fastenings for shoe buckles. Cl. R., 30 Geo. 3, p. 1, No. 15. Dec. 8 last; Jan. 8, 30 Geo. 3, 1790.

George Coates, of Shoe-lane, London, carpenter: of " an invention of a machine for washing, scouring, or cleansing linen, cotton, and woollen cloths, or any other woven or knit fabric," which may be worked by a pendulum or other lever, or by a revolving motion. Cl. R., 30 Geo. 3, p. 1, No. 14. December 12, 30 Geo. 3; Jan. 11, 1790.

Joseph Bramah, of Piccadilly, engine maker, and *Thomas Dickinson*, of Bedworth-close (Warwick), gent.: of " a new improved engine or machine on a rotative principle," which has undergone a very copious description in a former patent, and is a machine calculated for a great variety of applications which may from time to time render sundry non-essential variations in its construction necessary. Cl. R., 30 Geo. 3, p. 1, No. 4. Jan. 15, 30 Geo. 3; Feb. 13, 1790.

John Dring, of Walworth, Newington (Surrey), brass worker and hydrometer maker: of a certain improvement on all cocks, which from the nature of such improvement are termed ball cocks, which said improvement consists of inclosing in the body of the said cock, that part of the key that is pierced through for the purpose of retaining and letting out the liquid contained in the vessels, which part of the key so inclosed is in the form of a ball or cone, or oblique, or scaline cylinder, and by inclosing an internal screw in water ball cocks; the whole of which improvement is designed to preserve the said cocks in a perfect state, not liable to those imperfections that all mettle cocks hitherto made have been subject unto. Cl. R., 30 Geo. 3, p. 1, No. 3. Jan. 20, 30 Geo. 3; February 9, 1790.

Thomas Ribright, of the Poultry, London, mathematical instrument maker: of an instrument to serve as an artificial horizon, by means of which the sun's altitude may be taken at sea, with a Hadley quadrant, and the latitude found when the real horizon is obscured or invisible. Cl. R., 30 Geo. 3, p. 1, No. 1. March 2, 30 Geo. 3; March 22, 30 Geo. 3, 1790.

Samuel Hooper, of St. Giles-in-the-Fields, bookseller and stationer: of a new invention for manufacturing from leather, leath tings, shavings, or parings of every l leather whatsoever, and whit lea leather for covering the fronts, backs and tops of coaches, &c., and trunl for making band, hat and other waiters, tea trays, &c., mouldings, cc &c. for rooms, and for binding of and, with some variation in the p paper for copper plate printing, bro white-brown paper, and for drawing. 30 Geo. 3, p. 2, No. 5. Jan. 20, 30 (Feb. 19, 1790.

James Tate, of St. Mary-le-bone monger: of an invention of a machin an improved principle, for the purp raising of ballast, discharging the car ships, and otherwise assisting in th formance of many useful and lat works. Cl. R., 30 Geo. 3, p. 3, March 13, 30 Geo. 3; April 12, 179

William Freemantle, of Aldersgate- London, watchmaker: of an impro on the vertical weight and spring r jacks, which render the same less c cated. Cl. R., 30 Geo. 3, p. 3,] March 24, 30 Geo. 3; April 13, 179

Charles Earl Stanhope: of " a r of constructing ships and vessels, moving and conducting them with gr locity without the help of sails, an moving and conducting them against waves, current, or tide, or against the of them all united;" involving a p build of ship, having head and stern same shape, so as to navigate narrow without turning, and sail with and s wind, called by the Specifier, An Amb vigator; also a peculiar kind of r called by the Specifier, An Equipollant der, and machinery for propelling the to be set in motion by men, hors steam. Cl. R., 30 Geo. 3, p. 4, N March 13, 30 Geo. 3; May 7, 1790.

George Holland, of St. Andrew, H above the Bars, frame work knitter new sort of manufacture of stockings, g mits, socks, caps, coats, waistcoats, bre and other articles of clothing and l of clothing, and other things where w is required, and also of blankets, ca and tapestry, and in imitation and t swer to the purposes of furs and ski various kinds, a thing never before p practice. Cl. R., 30 Geo. 3; p. 4, N March 20, 30 Geo. 3: April 19, 1790

Henry Downer, of Fleet-street, Lo ironmonger: of an invention of a sprit the purpose of shutting a door. Cl 30 Geo. 3, p. 4, No. 8. April 13, 30 G May 12, 1790.

(*To be continued.*)

LIST OF ENGLISH PATENTS GRANTED FROM AUGUST 5 TO AUGUST 13, 1847.

Benjamin Bailey, of Leicester, machine maker, for improvements in the manufacture of knitted fabrics. August 6; six months.

LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED UNDER 6 AND 7 VIC. CAP. 65.

Date of Registration.	No. in the Register.	Proprietors' Names.	Address.	Subject of Design.
Aug. 4	1158	W. Grounsell	Louth, machine maker	Improved winnowing machine.
"	1159	Jas. Basire, Jun.	Red Lion-square, London, engraver	Improved blade protractor.
6	1160	John Parsons	Nottingham, brace-maker	The Albert brace,
7	1161	Simister and Holland	Cheapside, London	Ladies' petticoat, or dress dilator.
"	1162	Simister and Holland	Cheapside, London	The dilator.
"	1163	The Crane Foundry Company	Wolverhampton	Sash-pulley, box, or frame.
11	1164	Charles John Rowlands	Birkenhead, shirt-collar maker	Band of shirt-collars.

Advertisements.

CONTENTS OF THIS NUMBER.

LONDON: Edited, Printed, and Published, by Joseph Clinton Robertson, of No. 166, Fleet-street, in the City of London.—Sold by A. and W. Galignani, Rue Vivienne, Paris; Machin and Co., Dublin; W. C. Campbell and Co., Hamburgh.

Mechanics' Magazine,
MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 1254.] SATURDAY, AUGUST 21. [Price 3d.
Edited by J. C. Robertson, 166 Fleet-street.

CRADDOCK'S HIGH-PRESSURE, EXPANSIVE, AND CONDENSING MARINE ENGINE.

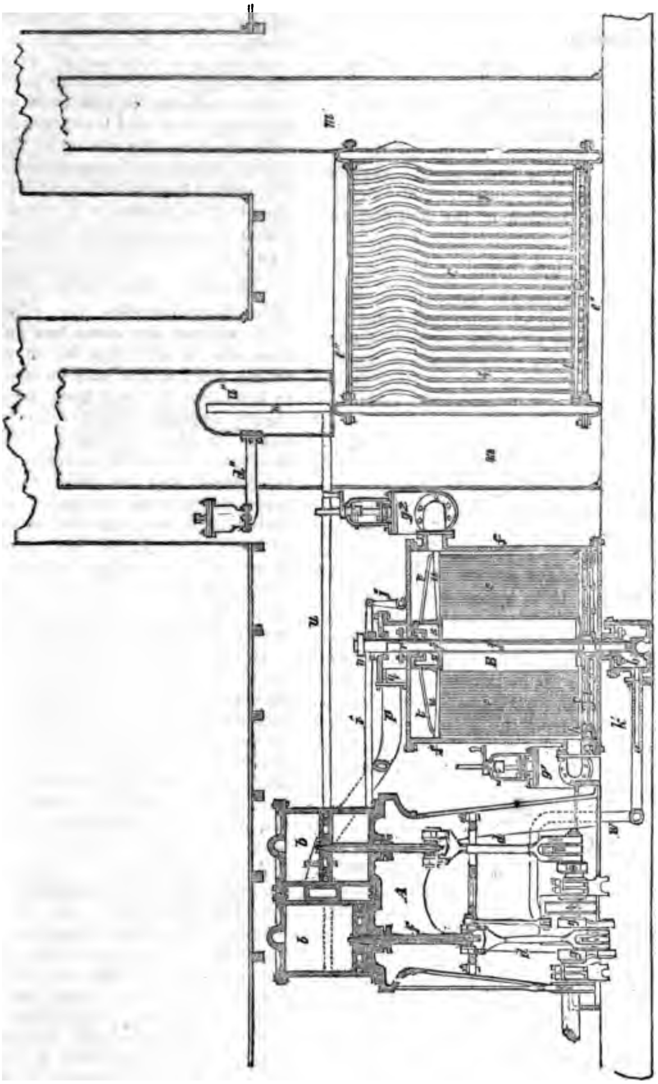


Fig. 23.

MR. CRADDOCK'S HIGH-PRESSURE, EXPANSION, AND CONDENSING SYSTE TO MARINE ENGINES.

(In continuation from page 157.)

We now proceed to show the application of Mr. Craddock's system to the working by direct-action of Screw and other Sub-marine propellers, and shall first point out in what respects the arrangements in this case differ from those of the stationary engine described in a former number.

Fig. 23 is a longitudinal section of a pair of oscillating twin engines, boiler, furnace, and condenser—the whole of which are supposed to be placed on the same level; figure 24 a transverse section of the engines; figure 25 a plan of the engines, boiler, furnace, and condenser; and fig. 26 a longitudinal section of the boat and engines.

The Boiler.

The boiler is on the same principle as that before described, only that there are four quadrangles of tubes instead of one, and two additional rows of tubes, one on each side, as also four fire gratings (each divided in the middle as before) to correspond; and that the whole is enclosed in iron instead of being set in brick. A transverse section on the line $e^a f^a$ on an enlarged scale is given in fig. 27. Between the two outermost quadrangles and the additional rows of pipes R^1 R^1, there are spaces *b b* left which serve as substitutes for the brick flues in the furnace before described. At the two ends, these spaces *b b* widen into the larger flue spaces *c c*, which terminate in two funnels *d* and d^1; the former being elongated in one of its diameters to hold the steam chest, as in the arrangement first before described. *z z* is the pipe which conveys the steam from the steam chest to the high pressure cylinders *a a*. The furnace in this case is fed from doors at the side, as shown in fig. 25.

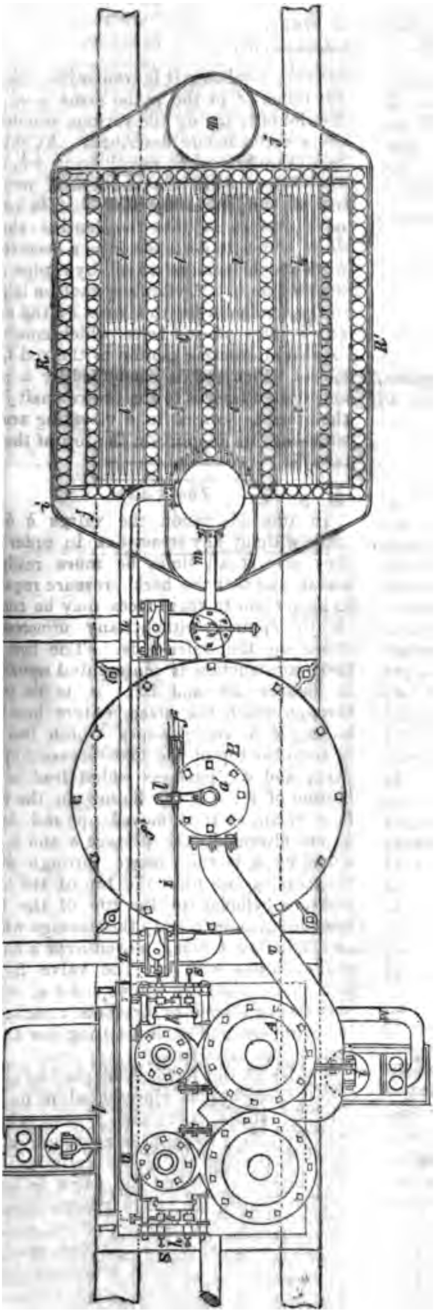
The Condenser.

The condenser is here placed within a cistern *f f* on the floor of the vessel, which is provided with two sluice valves g^1 and g^2; one (g^1) for admitting cold water into the cistern, and the other (g^2) for allowing the heated water to flow out into the sea or river. The exhaust steam passes from the two low pressure cylinders up the pipe *p* into a chamber *q* in the head of the condenser, from which it enters through slots *r* into the interior of the hollow central shaft *j*, from which it again emerges through similar slots r^2 into an annular receiver *s*, whence it is transmi the tubes *t t* to the radial arm distribute it among the various pipes *e e*, as before described. tom there are other radial arm ring *h*, to receive the condens before; and from the ring *h* i ed by pipes *i i* into the cent down which it descends into a from which it is carried off by the air-pump. A vibratory mo to the condenser in this case b of a weigh shaft and lever, whic cate an alternating motion to th end of which rod is connected and slotted lever *n* to the centre the other is jointed to a vibra which has its support on the to tern f^1.

The Valves.

In this adaptation the valv made without any steam-box in they may at all times be mor access, and that the back pressu to keep them to their faces may niently applied without any strain on the valve-rods. Th their construction is represente in figures 28 and 29; *a* i through which the steam enter boiler; *b b* are passages whic or from the top of the high-pre ders; and *c c* passages which bottom of it; *k* is the hollow i face which, as it is moved up covers alternately the passage *a* *a* and *c*; *h* is the passage thro the steam passes from the top o pressure cylinder to the top o pressure cylinder; and *j* the pass on the hollow *k* being moved ov communicates with *c*. The val held to its place by screws *s s* pass through arms or brackets the cylinders, and press a spring back of the valve face.

A valve of this form, as adapte cylinder engines, is represented *a* is the steam port, and *f* th branch; *c* is a steam passage co ing with the bottom of the cyli the slide valve. When the valve position shown, the steam passe boiler through the steam port passage to the top of the cylinder lower part of the cylinder is in co tion with the exhaust pipe *f*, and t *c* with the steam port *a*.



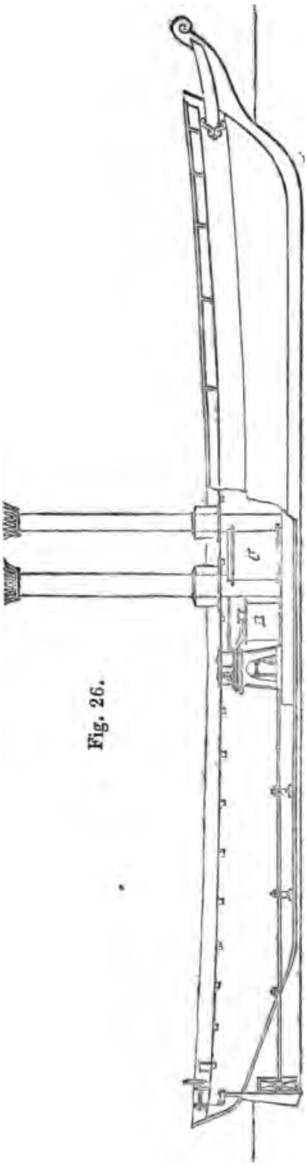


Fig. 26.

The peculiarities in this arrangement most deserving of attention are the following:

1st, The angular mode of connecting each pair of cylinders; whereby one valve, one eccentric, one cross-head, one connecting-rod, and one steam-box, are made to serve the purposes of both cylinders, and a proportional saving of weight and room is effected.

2d, The great simplicity and efficiency of the "one valve," which is such as to admit of the steam being cut off at any part of the stroke from one-half to one-twentieth. According to the views which Mr. Craddock entertains (*Chemistry of the Steam Engine*) on the subject of high pressure steam, this facility for working it expansively becomes an object of the first importance. He is for

Fig. 27.

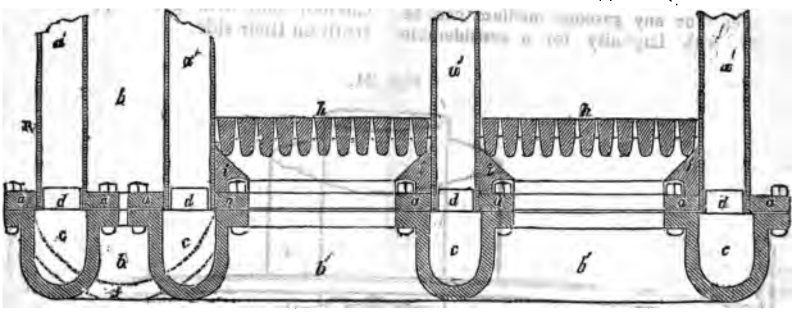


Fig. 29.

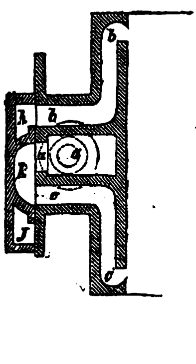


Fig. 28.

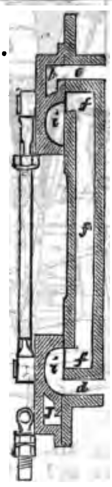


Fig. 30.

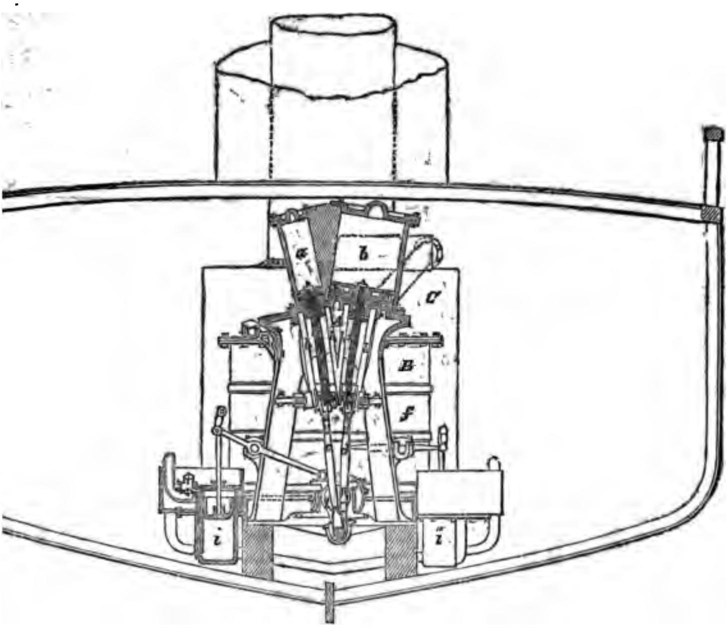
using it at a pressure in the boiler of not less than 115 lbs.—derides the idea of any danger attending it in boilers constructed like his, or, indeed, in any well-arranged boiler on the tubular plan—and anticipates that "many years will not pass before 200 lbs. pressure per square will be used."

"One can scarcely forbear to smile at the complacency with which even 1000 lbs. pressure is proposed and received by the public, when that pressure is the result of *compressed* air. Yet, I must confess myself unable to see the grounds of complacency in this case, and of fear in the case in which I propose a comparatively very low pressure for steam; for the air, under such circumstances, is certainly the more dangerous of the two, for when the water from which the steam is generated is contained in tubes, the danger from the water, under such circumstances, may be said to be completely prevented, while steam partakes of no property more dangerous than compressed air. But here will occur to some the danger from the heat of the steam; but it deserves to be generally known, that the higher the

re of steam previous to its rushing vessel, the lower becomes its temper- y its expansive force; and the mere f the steam, under such circum- , is completely harmless. Another rity due to steam, in common with ëriform bodies, is this, that by the lated state of the particles of matter h it is composed, it does not impart , nor extract it from, other sub- with anything like the rapidity of such as water; hence, a temperature n water would be destructive to life, n or any gaseous medium can be with impunity for a considerable length of time, especially if the steam or gas be quiescent."

3rd, The immersion of the condenser in water. The system of condensation, with which Mr. Craddock's most obviously challenges a comparison, is the well known one of Mr. Samuel Hall's. We shall lay before our readers Mr. Craddock's own views of the advantages which he has realized over his rival, and without identifying ourselves with them, we may say that they are stated with candour and with great appearance of truth on their side.

Fig. 24.



making a comparison with Mr. lan, I shall first quote as far as I m his own data. First he gives inches of steam per minute at 4 lbs. e inch above the atmosphere, as the r necessary for the production of se power; from this quantity of hesitate not to affirm, that with the I am here advocating, and with the er in water, we can produce *three* ower. Mr. Hall next gives 20 feet of surface in the condenser, as quisite for the condensation of this y of steam per minute; whereas, by the condenser motion in water, in accordance with my principle, we can effect this amount of condensation with 15 square feet of surface. We have thence a reduction of the amount of surface requisite for the condenser per horse power, from 20 feet to 5 feet. The next peculiarity of Mr. Hall's plan is, the moving of 10 gallons of water per minute per horse power, by means of a pump or pumps, through or amongst his stationary condensing pipes, which are studded as thickly as possible into plates at top and bottom; these plates being enclosed, a steam-chamber is formed at the top, from which the steam passes through the pipes to another chamber similarly formed at the

bottom; from thence the condensed steam is drawn off for the use of the boiler. The joints of Mr. Hall's condenser are what are .ermed packing-joints, without any provision for expansion and contraction, otherwise than by the tubes moving to and fro through the packing-joint. Without intending to call in question the efficiency of this joint in water, I can speak from experience, that it is utterly valueless in obtaining a vacuum when condensing with the atmosphere, as I made use of Mr. Hall's joint when I commenced making my condensers; but I found that, however well made, and tight when first put in action, it remained so but for a few days, when I found it impossible to keep a vacuum, and was obliged to take the condenser to pieces, and to make provision for expansion, by bending the tubes, and also to make the joints in the manner shown in fig. 14. The end of the tube and hole in which it is inserted are first tinned, the tube is swelled out on the one side, and flanged over on the other; each of the leaves, when made, is simply dipped in a cistern of melted tin; the joinings are then complete, the metals being united. So simple and effective is this joint, that I think I could undertake, without hesitation, to make 1,000,000 of them without a leaky one; but this is not their only advantage compared with Mr. Hall's joints, as they are made at one-tenth of the expense.

"In contrasting my condenser with Mr. Hall's, *seven* items of essential moment stand in a very different relation.

"The *first* is, that by using high-pressure steam expansively, I have but one-third the quantity to condense for the same amount of power.

"*Secondly*, owing to the motion I give to the condenser in liquid, not only will there be less absorption of power, than in drawing or forcing the water by means of pumps, as in his case, but a much more rapid abstraction of heat will ensue from the greater rapidity and uniformity with which the particles of the water will be brought into contact with the hot surface.

* * * *

"Here is surface brought into contact with many tons of water in a very short space of time by the power of one horse. I may ask, could this mass of particles of water be in any other way so easily brought into contact with this surface?

"In giving motion to the condenser, I avail myself of the law by which fluids expanded by heat are forced upwards by colder portions of the same, which are continually rushing in to supply their place. I therefore place the condenser in such a manner as to communicate at bottom with the cold water of the ocean, while at top the heated water is allowed to flow away condenser being put in motion wi into rapid contact with its hot surf particles of water surrounding it, an same time will assist the natural current before spoken of. This is stitute for Mr. Hall's *third* provisi pumps for removing or bringing th into contact with his condenser.

"A *fourth* circumstance relating Hall's condenser, is one which h stated to me as an objection to it, in turbid waters, owing to the tub so thickly set together, the filth accu in the centre of the condenser, and much impairs its efficiency; this is jection I think most persons would posed to anticipate, who have closely the effect of any obstruction to water through or along solids, as may be in the current of rivers. * * * fore, when we consider the multip obstructing tubes, which, in Mr condenser, destroy the motion of th cles of water ere they arrive at th we see a reason for the objection, a strong probability that the mobili particles of water in the centre, is as its author would desire; while, as this is the case, there is want essential condition for the quickest tion of heat.

"*Fifthly*, I have shown the grea plicity and tightness of the joint I u

"*Sixthly*, as I dispense with pu moving the water, I also save their room, and weight.

"*Seventhly*, I have heard, as an o to Mr. Hall's condenser, that it is a matter to detect a leaky tube, wh may exist, and that the tubes are s difficult of access in case of repairs. I most completely meet this objectio my case, the condenser is put togethe rate leaves, each leaf being connecte screw pins and a union joint; only to undo these, when we can any individual leaf, the condenser respects remaining as efficient for pose as before; while, with the leaf we have as great convenience for or repairing it as can be require objection, I feel assured, is so ef met, as to silence the most prejudice this mode of condensation."

Mr. Craddock indulges in a calc excusable enough, of the natio vantages which would be realis his system only generally adopte

"To come as close as possible to comparison, we will suppose the power of the *Great Britain* steam be 1200 horse. We will suppose st

ely, and generated in tubular boilers, pressure of 115 lbs. per square inch. is beyond a question that steam so l, and used expansively, will pro-*ble* the amount of power from any ight of coals consumed for its pro-which it will produce if generated pressure of only 18 or 20 lbs. on e inch.

* * *

s, therefore, suppose a voyage to between Liverpool and New York, y *672* hours, and to produce a ual to 828 tons of coals, at a cost er ton, we have here a saving of ding. But the saving would be ter than this in the reduction of is freight, consequent upon the l quantity of coals, with very much t and bulk of machinery. I firmly at the saving here would be two-ere saving arising from the con-of a less quantity of coal. But I it at 414*l.* also, or a clear gain 28*l.* sterling, upon each voyage to between the above-named places. eight such voyages in the year, ; would amount to 6,624*l.* ster-

is be the saving which would be one steam-vessel per annum, it is calculate what would be the saving pplication of such principles to rine steam-engines, even in Great not to speak here of its application ous countries of the world."

cult to calculate" indeed! May twentieth part of the saving be realized, and not only will and the world be everlastingly o our ingenious and enthusias-but Mr. Craddock himself (if perience the same share of fair ifferent as it was—of his great WATT) secure to himself a iable harvest of profit and re-

daptation of Mr. Craddock's Railway Locomotives in our cceeding Number.]

YACHT SAILING.

Having observed in the 1249th of your Magazine that Mr. cGregor wishes that some of cal correspondents would throw tional light upon the setting of ls, and more particularly their ore-sails; I presume to make it from a feeling of conviction that few persons have entertained the subject equally with myself.

In allusion to jibs, it must first be perfectly understood that all jibs and stay-sails are very imperfect sails, by reason of their luffs being partly in a horizontal direction, and not in the plane of their feet and after-leaches. This imperfection is null when the fore-leach, or luff is in the perpendicular direction, and greatest when it is in the horizontal one, when the sail (if it were the form of an equilateral triangle) would have no propelling power *whatever* endways. The evil, then, is in proportion to the angle which the luff of the jib makes from the perpendicular, or the mast. Practice has detected the evil (perhaps without knowing the cause), and sailmakers by their ingenuity have done their best to correct it. Thus, by way of reducing the lateral pressure of the sail, situated near the luff, they allow it to belly there, as shown in Mr. MacGregor's fig. 1. Now, although my notion is that a sail should stand as flat as a board, according to Mr. MacGregor's fig. 2, yet I affirm that as a jib does not move in a plane, the sailmakers' correction was judicious by diminishing the lateral and non-effective propelling power of the sail. If Mr. MacGregor will cut a flat and thin board to the shape of his jib, stick two pins about one-third from the fore port on the luff and foot, so as to admit the jib to turn upon an axis there, he will clearly see, not only what I mean by a perfect movable plane, but at once appreciate all its advantages over the present jibs and fore-sails. In fact, I am greatly indebted to that quality for the superiority of my revolving masted rig in sailing close hauled, which so far surpassed my expectation that the discovery of the cause followed after the invention. The other principal cause is, that the weights of the revolving rig are balanced, there being as much weight over to windward as to leeward; whereas all other "fore and aft" rigged vessels have the weights of their sails and spars over to leeward, to the great diminution of their stability.

With regard to a cutter's main-sail, the ingenuity of sailmakers has also lessened its imperfections. They will understand the evil of a taut after-leach, which causes the sail to belly towards it. By their manner of gradually sew-

ing the seams of the cloths slacker and slacker as they approach the after-leach, they have succeeded in making the sail stand tolerably flat at the expense of some loss of power by the shaking of the after-leach.

My aim has been to find out the most perfect sail for going to windward, even if such a sail should be impracticable on a large scale. The result of my endeavours is, that a sail should be perfectly flat from the fore end to its centre, and then that it should gradually bend in a parabolic curve to leeward, so as to be convex, or (to use a more familiar term) belly to windward. This convexity may be too great, but kept within certain limits, it is by far the best form; and if the sail could be made so as to spring with the vessel's motion and the unequal puffs of wind, it would still more approach to perfection. I have put it into operation as far as was practically possible, by making a triangular sail with the after-leach, forming an arc of a circle, and so maintained by the help of spreaders radiating at equal distances from the fore part of the sail, thus forming the sail on the principle of a bat's or butterfly's wing. These spreaders being elastic, caused the sail to belly to windward in the way I have mentioned. Although the bat and butterfly principle of cutting sails may not be practicable (except in Chinese junks) on a large scale, on account of the greater weight and non-elasticity of spreaders; yet it is useful to nautical science that the nearest approximation to what a sail ought to be, should be known and understood, and then let practice do its best.

I hope I have sufficiently intruded upon your pages to give some satisfaction to Mr. MacGregor; at any rate, I think my ideas will be found novel to him. I am, Sir, yours, &c.,

MOLYNEUX SHULDHAM.
Commander, R.N.

Boulogne-sur-Mer, August 16, 1847.

"CAN A BALLOON ASCEND IN VACUO?"—MR. MACGREGOR IN EXPLANATION.

Sir,—I gladly admit that the meaning which I erroneously attached to the words of "A. H." in a former communication, page 4, was not that which he intended them to convey. The fault of misconception was probably mine, and not one consequent on obscurity in the referred to. The expression into play an external force," a to me to apply the word *extern* simple re-action, which, though c dependent upon external circun for existence, is no less depende forces internal (in the machine exhibition. I properly reserved for further explanation, and to this, proposed a case where, at the of the first action of the interna there is no external force in bei to the stability of the centre of I, of course, assent equally with " to the acknowledged law; but that he will allow, that in his sta at page 4, he has so worded the tw as to lead us to infer that when th is removed, a new force is cal play.

I am, Sir, yours, &c.,
JOHN MACGR

Battersea, Aug. 15, 1847.

THE BRITANNIA TUNNEL BRIDG THE MENAI STRAITS.—GENER LEY'S LETTER AND MR. STEPH REPLY.

General Pasley addressed lately a the *Times* in which he made the f statements in reference to this struct give them in a somewhat abridged f

As it is well known, that when e before a select committee of the H Commons on the sixth of May, 184 means of passing the Chester and H Railway over the Menai Straits, I a of the tubular bridge then proposed Robert Stephenson, engineer of th pany, I think it is a duty to mysel to the public, to offer some observa the various projects for effecting t object, successively brought forward or which that alluded to was the sec

In his first plan, February, 18 Stephenson proposed to throw a substantial bridge, with two segmen iron arches, each of 350 ft. span, c Menai Straits, having a clear heigh the water of 116 ft. in the centre, 50 ft. at the springing of each c arches, which were to be supporte intermediate pier of masonry 120 fe on a shoal called Britannia Rock, two abutments, also of masonry. I of operation for putting the pieces for his arches together successively, balance each other, by working o from the upper part of the pier and

ts, until his semi-arches should meet ›entre of each opening, seemed to be crude and ill-digested at the d either impracticable, or nearly ave Mr. Stephenson my opinion, ›onsequence of the impossibility of any support from below, a sus- bridge, such as that previously y Mr. Telford over the same straits, ing everywhere 100 ft. high, offers iment to the navigation, and having sent state strength enough to bear .t of the heaviest railway train, but safety, owing to the flexibility and ıary undulations of the roadway in wind, might be rendered efficient ailway purposes by four vertical ne on each side of the two lines of ich, if of sufficient depth, would that rigid inflexibility of roadway, 'hich no railway bridge can be con- ıafe; a principle first adopted by ıey Clark in the construction of the n bridge at Hammersmith, and ently by Mr. Rendell, with no less in his repairs of the suspension Montrose, after one-third of the had been carried away by a storm, lth of October, 1838. I further . to Mr. Stephenson, that a sus- ›ridge for passing a railway over the raits might be trussed to advant- rought-iron lattice work, such as MacNeill had adopted for passing .n and Drogheda Railway over the anal near Dublin, by a bridge of ›an. Afterwards the Lords of the y employed Sir John Rennie and dell, civil engineers, and Captain .N., to examine that part of the :raits where the railway bridge was , and to consider what conditions ıght necessary to prevent the navi- :om being injured. On receiving ›rt, the Admiralty required that the and Holyhead Railway Company, ıg their bridge over the Menai .hould not construct the central pier nnia Rock wider or longer than 50 that there should be two openings it and the abutments, each 450 ft. width, and everywhere to be of 105 ear height above high water level.

. Stephenson's second plan, when ged to withdraw the former, was to uspension bridge of the usual con- , in order to obtain a platform for .er operations as I had before sug- But the sort of bridge which he ›osed to put together by this means novel and very ingenious construc- sisting of two large tubes of boiler ptical in section, and each measuring 30 feet by 15, in clear height and width; and he proposed that these tubes, though resting on a central pier of masonry, were to pass entirely across the Straits from one side to the other. Observing the conditions prescribed by the Admiralty, it is evident that they could not be much less than 1,000 feet in length, when finished.

On the 5th of April, and afterwards on the 6th of May, 1845, Mr. R. Stephenson admitted, in examination before the Select Committee of the House of Commons, that the above was the only possible mode of throwing a bridge of such large openings over the Menai Straits, but he had so much confidence in the strength and rigidity of his proposed tubes, that, after they should be placed he thought the suspension apparatus might be removed with safety. When I was examined by the same Committee, on the last-named day, I gave my opinion that the tubular bridge proposed by him would be strong and safe; and that when properly fixed, it would not be injured by gales of wind, though I was not convinced that such tubes would be better than vertical trusses; but I differed entirely from the suggestion Mr. Stephenson had thrown out, as to the expediency of removing the suspension apparatus—a measure which I thought would not only be unnecessary, but that it might endanger the security of the bridge.

From this, his second project, Mr. Stephenson has since departed, having been induced to give up elliptical and adopt rectangular tubes, in consequence of experiments tried, at his request, in 1846, by Mr. W. Fairbairn and Mr. E. Hodgkinson, both very experienced and skilful in the uses of iron, as applied to practical architecture and engineering. Not so, the decision afterwards adopted by Mr. Stephenson, of abandoning the suspension principle altogether; instead of which he now proposes to put together in succession each of his tubes, which, according to this new arrangement, will be four in number, on a bridge of boats, which will first be formed parallel to the shore, and will then be swung into the proper transverse position by the quarter-circle movement, common in the practice of military bridges, after which the tube is to be suspended by chains; and though either of the sides will expose to the wind a surface of at least 1,400 square feet, considerably exceeding the area of all the sails of a 28 gun ship, and will weigh, as I am told, about 1,200 tons, each of these unwieldy masses is to be raised up nearly 100 feet by hydrostatic pressure, and thus deposited and fixed on the lofty pier and abutment of masonry. I feel it my duty to express my entire dis-

sent from this rash, if not impracticable, plan of operation, which cannot even be attempted without the risk of some very serious disaster, except at the high water slack of a neap tide, and in a perfect calm.

He has now, to my knowledge, proposed three projects, which have just been described, all widely differing from each other, for passing the Chester and Holyhead Railway over the Menai Straits; and I think that his second plan, the only one which I approve, would have been sufficiently arduous in itself without adding to the difficulty, and diminishing the safety, of the attempt by the abandonment of the suspension principle; if he persists in this, his third plan of operation, the chances are, that the first tube which he attempts to raise will find its way to the bottom of the straits.

Since the publication of General Pasley's letter, there has been a meeting of the Chester and Holyhead Railway Company, at which Mr. Stephenson replied to the General in the following terms. We quote the *Railway Record's* report:

"General Pasley makes only a statement, or rather gives a detail of conversations which took place between us relative to the principle of the use of iron-tube bridges. General Pasley states that at first he approved of the principle adopted by me, and there is not in his letter one paragraph to condemn that principle—nay, he distinctly repeats that he approves of the principle. What he complains of is the mode of erecting the tube. Now, Gentlemen, there are only two or three persons who know the facts connected with the mode proposed, and General Pasley cannot possibly be in possession of any information which can at all justify his prediction. (Hear, hear, hear.) The original plan was to use chains to raise the tube to a level with the platform of the railway, which chains could be removed when the tube was fixed. Afterwards, we altered the mode of raising the tube; and it is only to this mode about which General Pasley cannot know anything—for, as I have said, it has been confided only to two or three persons—that objection is taken. I believe any apprehensions that may be entertained are of a very vague character, and that it is mainly the novelty of the plan which gives rise to such apprehensions. I believe the objections have nothing in them; the plan is only an application on a gigantic scale of an old principle.

I beg to say, Gentlemen, that they have created no apprehension whatever in my mind; they have not altered my convictions in the slightest degree: and though all great works, difficulties doubtl arise in the course of their executio difficulties, I am satisfied, will only as will suggest the remedy as the (Hear.) I believe nothing will occu we shall not be able to correct. I sh self be on the spot; and I repe though I never knew any great work kind in which difficulties have not entertain no doubt that in this case t be readily surmounted. (Hear, h beg, therefore, that the proprietors miss all apprehensions on this poi their minds. The scheme involved l experimental investigations, exceedi thing that had ever taken place befo I felt that a large expense was fairly to test and settle the details of the (Hear, hear.) I believe we have so the matter; and I have reason to kn the most eminent engineers and mat cians approve of the principle. hear.)

Mr. HENMAN had understood Pasley's objection to be, that Mr. S son now intended to abandon the sus principle which he had originally fixe Now, he would be glad to know Stephenson was of opinion that th being of so large a span as 450 feet be able to bear the trains, and withst vibration, without support from eh intermediate points.

Mr. STEPHENSON.—I wish it to tinctly understood that I never desig chains should form an essential part permanent structure; they were or proposed, not for supporting the tu for raising it. As we proceeded, I that, by increasing the weight and s rather, I should say, the weight or the size has never been altered—we co pense with the chains altogether. I that it may be looked upon as fully that, as respects the strength of the the chains would rather be a detri than otherwise. As regards vibratio are certainly various opinions; but, own part, I think that no vibratio will be felt. (Hear, hear, hear.) M son is, the relative ratio of the wei the tube and the trains. Take, for in a train of even 100 tons, then, as th is to be 1,200 tons weight, I ask w with such relative weights, the tube i to be thrown into vibration? I sa impossible. If the ratio of weight reversed—if, for instance, the train be 1,200, and the tube 100, such vib would, undoubtedly, arise. I belie the tube will be as firm as a rock— will suffer no vibration at all; at lea

a everything does over which a
es. (Hear, hear.)

ote the following description of
adous work, in its present state of
from the letter of a correspondent
nchester Examiner:

suppose ourselves stationed in a
e middle of the Menai Straits, a
red yards distant from the new
the south side, and suppose it
re shall see a wonder of the world
d. First, there is the middle pier
of the water, founded on the
Rock, after which the bridge
This rock can be seen at low
he breadth of this pier is 62 feet
and a quarter of an inch. The
stone are 7 and 8 feet long by 3
t in breadth and deepness, and
stone upon stone, until the pier is
igh. At the distance of 460 feet
de of this centre pier there rise,
rater's edge, two other piers of the
atic breadth and height; while on
of these two piers, at the distance
t, there rise two walls. Continu-
rds, the wall on our right hand, on
rvon shore, does not extend its
bulk far back, for the land is
bold, and the railway comes along
d brow, and at once lays hold of
. But on our left hand, which is
sea shore, the wall is the forehead
f a mighty embankment, on which
ay is raised to the level of the
There, then, are the four spaces
, across which, in the iron tubes,
y is laid, namely, two spaces on
of the centre pier, of 460 feet each
ader measure 460 feet on a street
road, and he will wonder at the
of this structure); and two more
250 feet respectively, at each end.
s are eight in number, each of them
n the exterior side, and 27 feet high
erior. Each is 14 feet wide, and
laid in couples parallel to each
n the whole, with the breadth of
and the landward buildings, the
the bridge is one-third of a mile.
t the three piers are, as already
feet. Measuring from low-water
he bottom of the tubes, the height
t, the tubes being 30 feet on the
the pier 70 feet above their upper
As ornaments to the two walls
e upon each shore, are four lions,
ch end of the bridge. The lions
about 8,000 cubic feet of stone.
couched, and yet the height of
feet; the greatest breadth across
is nine feet, the length 25 feet, the breadth of each paw two feet four inches. The tubes are made of plates of iron of various thicknesses, riveted together. The iron increases in thickness as we proceed towards the centre. The roofs of the tubes are formed of cells, and also the floors. These cells are formed of iron plates set on edge, the cells of the roof being within a fraction of one foot nine inches square, and those of the floor being one foot nine inches wide, and two feet three inches deep. The rails on which the trains run are laid on the cells of the floor. The flat bottom, the two upright sides, and the flat roof of each tube are formed of plates, the thinnest of which is a quarter of an inch, and the thickest three quarters of an inch. The weight of each of the four long tubes will be about 1,300 tons; the weight of each of the four short ones, about 600 tons. In the whole, there will be at least 7,600 tons of iron used. The masonry was contracted for by B. J. Nowell and Co., at 130,000*l.*; but, from alterations in the plans, it will cost 200,000*l.* They expect to finish the masonry by August, 1848. It will contain 1,500,000 cubic feet of stone."

TIMBER MINING IN AMERICA.

On the north side of Maurice River Creek, New Jersey, the meadows and cedar swamps, as far up as the fast land, are filled with buried cedars to an unknown depth. In 1814 or 1815 an attempt was made to sink a well curb near Dennis Creek Landing, but after encountering much difficulty in cutting through a number of logs, the workmen were at last compelled to give up the attempt by finding, at the depth of twenty feet, a compact mass of cedar logs. It is a constant business near Dennis Creek to "mine cedar shingles." This is done by probing the soft mud of the swamps with poles, for the purpose of discovering buried cedar timber; and when a log is found, the mud is cleared off, the log cut up into proper lengths with a long one-handled saw, and these lengths split up into shingles and carried out of the swamp ready for sale. This kind of work gives constant employment to a large number of hands. The trees found are from four to five feet in diameter; they lie in every possible position, and some of them seem to have been buried for many centuries. Thus, stumps of trees which have grown to a greater age, and which have been decaying a century, are found standing in the place in which they grew, while the trunks of very aged cedars are lying horizontally under their roots. One of these instances is thus described in a manuscript from Dr. Beesley, of

Dennis Creek, who has himself "mined" many thousand cedar shingles, and is now engaged in the business:

"I have in my mine a cedar some 2½ feet over, under a large cedar stump, 6 feet in diameter. Upon counting the annual growths of the stump, I found there were 30 of them in an inch; so that there were 1,080 in the 3 feet from the centre to the outside of the tree. The stump must thus have been 1,080 years in growing. To all appearances the tree to which it belonged has been dead for centuries; for after a stump in these meadows decays down to the wet, there is no more decay—none at least that is perceptible. Now we have 1,080 years for the growth of the stump, and 500 for its decay, and 500 for the growth of the tree under it; for this must have grown and fallen before the tree, to which the stump belonged, sprouted. We are thus carried back for the term of perhaps 2,000 years, of which 1,500 are determined, beyond question, by the growth of the trees."

The better opinion is that these trees have gradually sunk through the soft mud of the swamps, after having attained their growth and fallen. Many, however, have decayed in their erect position, for the swamps are full of stumps standing as they grew.

Within a short distance of the mouth of Dennis Creek, and about three miles from any growing timber, can be seen at low water, in the bed of the stream, numerous cedar and pine stumps, about 6 feet below the surface of the meadow, with the bark still adhering to some, when the mud is removed. As one passes up the creek a few miles the stumps approach the surface, and near the edge of the live swamps they become very numerous.—*Scientific American.*

SINGULAR MAGNETIC ATTRACTION OF MUD.

Sir A. Mackenzie was the first to notice the attractive power of the mud at the bottom of some of the lakes of North America, which is sometimes so great that boats can with difficulty proceed along the surface. This extraordinary fact is thus stated:

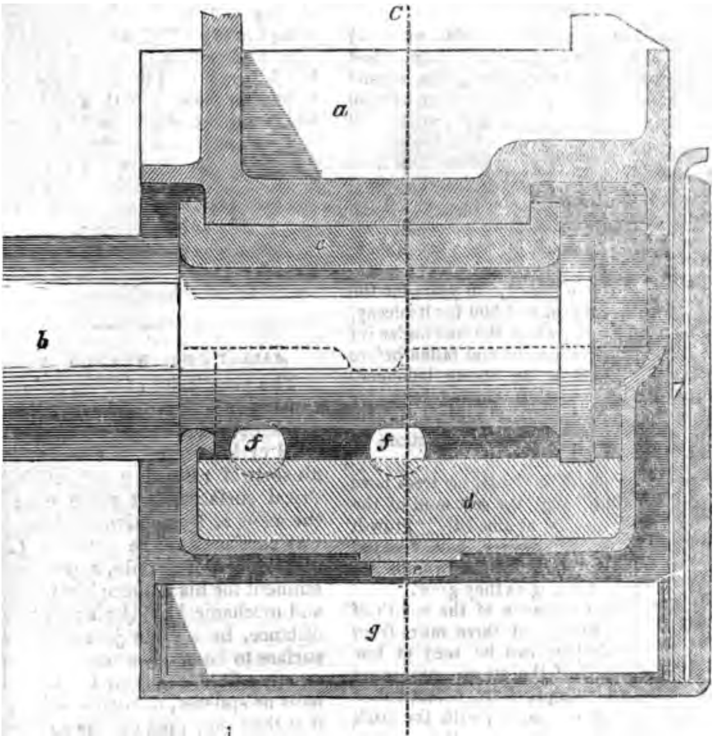
"At the portage or carrying-place of Matrees, on Rose Lake, the water is only three or four feet deep, and the bottom is muddy. I have often plunged into it a pole twelve feet long, with as much ease as if I merely plunged it into the water. Nevertheless this mud has a sort of magnetical effect on the boats, which is such that the paddles can with difficulty urge them on. This effect is not perceptible on the south side of the lake, where the water is deep, but it is more and more sensible as you approach the opposite shore. I have been assu[illegible] loaded boats have often been in d[illegible] sinking, and could only be extric[illegible] being towed by lighter boats. As fo[illegible] I have never been in danger of foun[illegible] but I have several times had great d[illegible] in passing the spot with six stout [illegible] whose utmost efforts could scarcel[illegible] come the attraction of the mud. A [illegible] phenomenon is observed on the lake [illegible] where it is with difficulty that a load [illegible] can be made to advance, but fortuna[illegible] spot is only 400 yards over."

This statement has since received c[illegible] ation from Captain Back and others, [illegible] the arctic land expeditions.

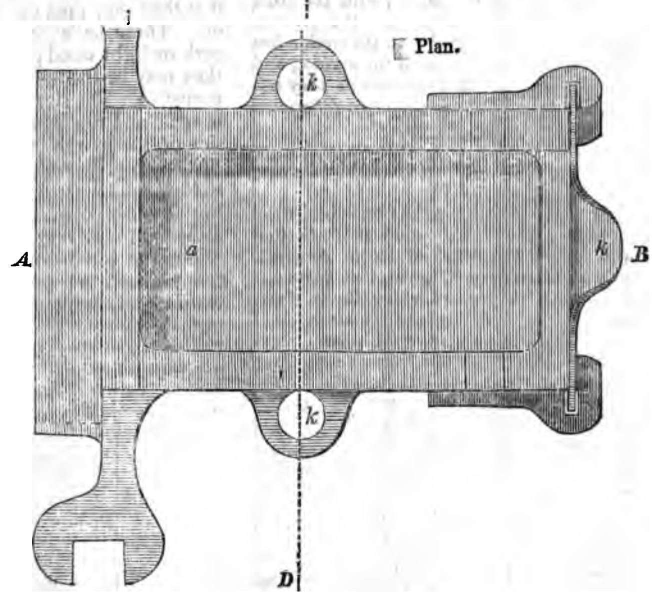
MALLET'S PATENT AXLE BEARI[illegible]

The peculiarity of these axle-b[illegible] consists in a novel and exceedingl[illegible] nious method of keeping them cont[illegible] oiled or lubricated. It is applic[illegible] all sorts of revolving and rolling [illegible] drical surfaces, but more especi[illegible] the axles of locomotive engines a[illegible] way carriages. The patentee (M[illegible] bert Mallet, of Dublin, a gentlem[illegible] eminent for his philosophical attai[illegible] and mechanical skill) places at a [illegible] distance, below the journal or r[illegible] surface to be oiled, a vessel contai[illegible] or other fluid unguent, and severa[illegible] balls or spheres, of such specific g[illegible] that they may float on the surface [illegible] oil. These balls or spheres ma[illegible] cork or light wood; or, if made [illegible] they may be made of glass, or m[illegible] porcelain. The size of the floating [illegible] is such, and the distance from th[illegible] side of the journal to the surface [illegible] oil is so adjusted, that the f[illegible] bodies shall always be in conta[illegible] the lower side of the journal, o[illegible] some part of it very near its lowe[illegible] When the journal or cylindrical [illegible] now caused to revolve in either di[illegible] upon its own axis, the slight fricti[illegible] tween its surface and that of the f[illegible] bodies is sufficient to cause these [illegible] volve also. They thus lick up [illegible] were) the oil, or other fluid in [illegible] they float, and continually apply it [illegible] under surface of the revolving a[illegible] journal. The superfluous portion [illegible] so applied to the axle or bear[illegible] swept off by the top brass or m[illegible] which the axle or journal is plac[illegible] the upper half of its circumference, [illegible] side towards which the surface

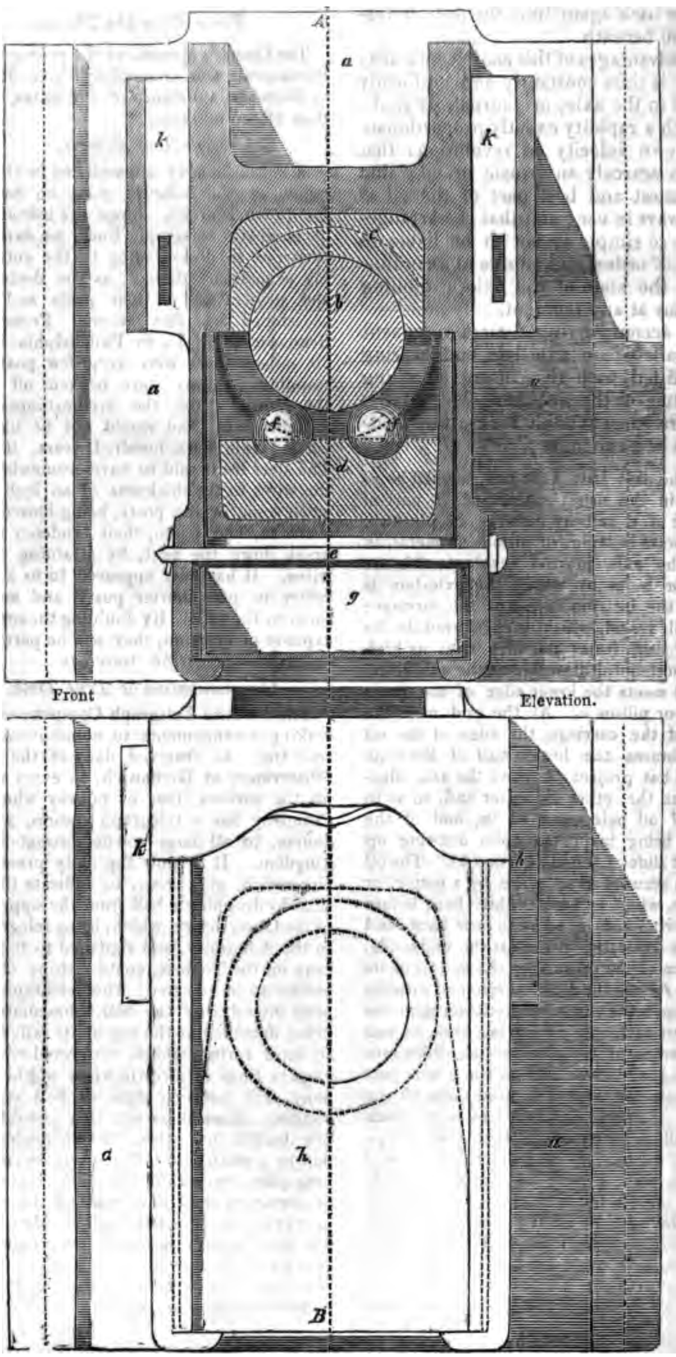
Section on the line A B.



Plan.



Section on C D.



Front Elevation.

r journal revolves, and from which s back again into the dish or vessel beneath.

ıdvantages of this contrivance are : is thus constantly and uniformly to the axle, or journal, or shaft, h a rapidity exactly proportionate own velocity of revolution; that scarcely any waste of oil; that nest and best part of the oil is ays in use; and that the arrangeso simple as not to be liable to of order, and admits of examinathe state of the axle and oiling s at any moment.

accompanying figures represent ils of an axle-box and bearing itted with this improved oiling us in the way that Mr. Mallet 's most suitable for railway locoand carriages:

e cast iron axle-box, formed so as a the usual axle guard; *b* part of of a railway carriage in place; *c* ass bearing, or pillow of metal, in e axle journal revolves; *k k* are r bolts by which the axle-box is the bearing spring of the carriage; vessel, which is preferred to be cast iron; its edge rises as high orizontal diameter of the axle journeets the lower edge of the brass or pillow *c*. At the end next the the carriage, the edge of the oil races the lower half of the axle but projects beyond the axle altot the other or outer end, so as to oil being poured in, and of the being inspected upon drawing up slide of the plate iron (*k*). The oil secured in its place by a cotter, or , which is very slightly bent before iven across, so as to bear hard, and ttle elasticity, against the underside, n of the oil box, at the middle of its *f f* are the balls or spheres, floating pon the oil, and in contact with the rt of the axle *b*; *g* is a tray, or box r, or of tin plate, which slides into in a rabbate cast on the lowest part le box, and is secured there by the The office of this tray is to catch l quantity of oil that may escape oil box *d*, or from the axle, and tray it may be returned readily oil box for further use. The floates may be of the shape of almost of revolution, but that of the sphere red.

COLLECTANEA ELECTRO-TELEGRAPHICA.

Voice from the Throne.

The Queen's speech, at the proroguing of Parliament, was transmitted from London to Norwich, a distance of 126 miles, in less than fifteen minutes.

Effect of Storms.

A storm, nearly unparalleled in violence, raged on the Atlantic coast on Saturday last (28th March). Since the introduction of magnetic telegraph lines, no event has occurred so discouraging to the enterprising proprietors thereof, as the destruction and prostration of their posts and wires, occasioned by this storm. From New Brunswick, N. J., to Philadelphia—about 50 miles—there were very few posts left standing. Many were broken off above the ground. But the circumstances were extraordinary, and would not be likely to occur again in a hundred years, if ever. The sleet ice is said to have accumulated on the wires to the thickness of an inch; and when some of the posts, being loosened by the rain, had fallen, their tendency was to break down the next, by straining on the wires. It has ever appeared to us a better policy to use shorter posts, and more of them to the mile. By doubling the ordinary expense of erection, they will be permanent and safe.—*Scientific American.*

Communication of True Time.

The Electric Telegraph Company are now making arrangements to communicate the true time, as observed daily at the Royal Observatory at Greenwich, to every station on the various lines of railway where the Company has a telegraph station, and, of course, to all large towns throughout the kingdom. It is now the daily practice at Greenwich, at 1 P.M., to indicate the true time by dropping a ball from the upper part of the Observatory, which, being telegraphed to the Admiralty, and signalled to the shipping on the Thames, enables ships' chronometers to be adjusted. The Telegraph Company intend that the ball, immediately on being detached at the top of its fall, should strike a spring, which, connected with the various lines of electric wires of the Company, will instantly strike a bell at every station. Thus it is not only possible and practicable, but what, in all probability, will be a matter of daily experience ere very long—that before the ball at the Greenwich Observatory shall have reached the ground in its fall, the electric bell at Manchester will have struck and been set ringing; so that we shall know it is 1 P.M. at Greenwich before the ball announcing that fact has finished falling a few feet.—*Kentish Herald.*

Reporting by Electric Telegraph.

The services of the electric-telegraph have at length been called into requisition for the purposes of the press. The second edition of the *Manchester Times*, Aug. 7, 1847, contains a report of a public meeting supplied by the above means; and this, we are informed by the proprietors, is the first time that the electric telegraph has been made available for such a purpose.

The Corn Market and Telegraph.

The weather having been lowering and occasionally wet in the neighbourhood of Manchester during the last two days, and still showery this morning, the anxiety of the commercial classes to know how the agricultural districts were affected, led us to inquire if the electric telegraph was yet extended far enough from Manchester to obtain information from the eastern counties. By the prompt attention of Mr. Cox, the superintendent, inquiries were made at the following places; and answers were returned, which we append:—Normanton, fine.—Derby, very dull.—York, fine.—Leeds, fine.—Nottingham, no rain, but dull and cold.—Rugby, rain.—Lincoln, moderately fine.—Newcastle-upon-Tyne, half-past 12, fine.—Scarborough, quarter to 1, fine.—Rochdale, 1 o'clock, fair.—A glance at the map of England will show that the weather is fine in the chief districts of agriculture east and north of the midlands.—*Manchester Examiner.*

The Longest Line—as yet.

New Haven was put into telegraphic communication with Toronto, Upper Canada, recently, and messages were instantly exchanged between the two cities. The route is *via* New York, Albany, Rochester, Buffalo, and then crossing the Niagara River below the falls, passes round Lake Ontario to Toronto, the entire distance being *nine hundred miles!* The experiment was a most successful one, and the distance was overcome with as much apparent ease and promptness as between New Haven and Hartford. It was the longest distance ever traversed by the lightning in a continuous unbroken line.

Baying at the Moon.

The Emperors of Russia and Austria have forbidden any person or company to construct lines of magnetic telegraph in their respective dominions without their special permission.

New Position for the Ground Plates, and New Battery Solution.

James M. Lindsey, superintendent of the Philadelphia-office of the Atlantic and Ohio Telegraphic Company, some time sir ing that the line worked badly, to an experiment, which has been su Heretofore all lines have used a plate connected with the battery, a ground circuit by this means. lines in Philadelphia exchange (five ber), Mr. L. thought this might cause of the difficulty—and resorte following: He disconnected the plate from the battery and connecte the roof of the building, simply by the end of the wire between the joi sheets of copper, since which time it well.

Mr. L. has also a solution which —dispensing with the use of sulph in the battery altogether. It is u said, on the Western Line, and w battery formerly had to be renew a week, with this one is not rene once a month. The decompositio zinc is very slight, yet the curre strong, if not stronger, than with phuric.

The above are stated to us as f correspondent, and without com published, we believing that some current has been avoided by the exp —*Scientific American*, 10 *July*, 18

Should Governments have the Supe ence?

It has been by many recommen Government should purchase the right of the magnetic telegraph, th polizing the right of all telegraphic nication; and in view of *some* adva be derived from such an arranger have felt inclined to favour it; bu of the rapid extension of lines in directions by individual enterprise led to consider in a more serious lig objections to having the excellent of telegraphic communication contr and dependent on, a party favouri tary or commissioner. It is tru considerable portion of the busine Post-office department is likely to l seded by the increasing facilities of te ing; but then the public will be i rably better accommodated under of competition, than with a go monopoly. For example, suppo telegraphic system to be under th of Government, if a branch line wer to be extended to a village at a short from a main line, a similar obseq tedious process must be performed the privilege that is required now t the establishment of a new mail ro to every such branch line the dep at the junction of the proposed bra

line, would be very likely to be We have already an example in of the Washington and Baltimore show that under the special control nment, favourites with extravagant ill be employed as superintendents, perhaps, less capable and attentive rs who might be employed by pri- panies at one-fourth the amount of oreover, the nature of the telegraph such as to require frequent extra in forwarding messages to individ- ether a ready and ample compen- is certain or otherwise; and this done, under a competition system, of the popularity of the line; but general government system, the superintendents would feel and act dependently of any consideration of their responsibility to the de- . And even the general system of ent under acts of congress, and ons from the post-master general, head of department, would not, in ability, be so judicious, and consist- the productiveness of the estab- and accommodation of the public, the control of men of more expe- nd consequently better judgment, al business operations; for a man blind indeed, who cannot see that of congress—a body composed ly of lawyers—have less knowledge linary business operations and re- its of the community, than a great of their constituents. Another ation to be examined is, the proba- at the government would be inclined t the telegraphic facilities in favour st-office and mail operations, by the le that our state legislature has and restricted railroad facilities to e more expensive and tardy opera- the canals. Government may, if it impose a tax on such telegraphic ications (or on those uttered verbally) t be construed to be "mailable ' but the effect of such an act would great measure proportionate to pub- ment with regard to the constitu- thereof; but intelligence, like water, stantly tend to flow in its most con- channels.—*Ibid.*

egraphing of Coming Storms.

sor Espy, so well known for his ations into the theory of storms, to add efficiency to his efforts, by f the magnetic telegraph. By this in connexion with the information from his previous inquiries, one of objects will probably soon be at- -that of ascertaining when a storm of dangerous magnitude commences, so that preparations for it may be made, both on the seaboard and in the interior.

Application to Fire-Engine Stations.

A novel project is on foot in the Common Council of New York to run a telegraph line from the fire look-out on the City Hall to each of the eighteen police stations, to give intelligence of the whereabouts of every fire, so that on hearing the great bell, a person in any part of the city can ascertain at the station-house where it is.—*Scientific American*, March 10th, 1847. [Anticipated in England; see *Mech. Mag.*, No. 1223, for Jan. 16th, 1847.]

The Proper Wire to be Used.

The directors of the New York and Buffalo Telegraphic Company, at their recent meeting in Utica, resolved to use in their operations an iron wire known as No. 10, weighing about 250 lbs. to the mile. The English companies adopt a wire called No. 7, which is much heavier and more lasting.

(*To be continued occasionally.*)

MESSRS. BRETT AND LITTLE'S ELECTRIC TELEGRAPH.

[Patent dated February 11, 1847. Specification enrolled August 11, 1847.]

The improvements claimed under this patent are ten in number. We shall give the claims in the words of the inventors; and such explanations of them as may be necessary to show their general scope also nearly in their own words.

FIRST CLAIM.

"We claim, as an improvement in electric telegraphs, the use of a ring, or piece of metal, partially magnetized, in combination with a reel or coil of wire, whereby, and wherein, the electric current so acts, that the motions take place in a direction transverse to the axis of the coil, and parallel, or nearly so, to the planes in which the wire, constituting the coil, lies."

The electric fluid is made to pass through a number of coils of fine wire, properly coated or covered with silk, or other suitable non-conducting material; which wire is wound round a flat reel, or reels, of ivory, or other suitable material. The ends of these fine wires are alternately brought into contact with the galvanic battery, by suitable arrangements, whereby the current is made to act on and give motion to a partially magnetized ring, or piece of metal, suspended and moving on a fixed centre in

a plane parallel to the side, or face, of the flat reel, about which the wire is coiled; that is to say, parallel to the planes in which the wire is so coiled; the motions of this partially magnetized ring being communicated to an indicator, or indicators, whose motions in connection with a peculiarly arranged dial-plate with symbols thereon, may be employed to designate letters, figures, or other conventional signals, and transmit intelligence by means of electricity.

The patentees say, "We wish it to be perfectly understood, that although we have described the foregoing, by the application of circular coils of fine wire prepared as above described, wound round or upon a flat circular reel or reels, in conjunction with a flat metallic partially magnetized ring, moving parallel with such coils of fine wire for the giving motion to inductors, by which letters, figures, or other conventional symbols are designated; the same motion can be obtained, and the same principle applied by other modifications and arrangements, but we prefer using and adopting the arrangement above described."

Several exemplifications of such modifications are afterwards given.

SECOND CLAIM.

"We claim, as an improvement in electric telegraphs, an indicator, or indicators, deriving motion respectively from a current of electricity transmitted through a coil arranged and acting on a partially magnetized ring or piece of metal, as above described, and the adaptation of such motions to communicating intelligence between distant places."

THIRD CLAIM.

"We claim, as an improvement in electric telegraphs, the adaptation of an indicator or indicators to a dial-plate, constructed and arranged as described."

On the dial-plate are two vertical columns containing numerals from 1 to 25. The centre of the plate is retained for the symbolic arrangement of letters and figures by which the whole of the letters of the alphabet can be designated. When the indicators are in a state of rest they are in an angular position; but when put in action they move to a position nearly vertical, but are prevented from passing the vertical line by a pendant bar. In transmitting a signal or signals the letters of the alphabet are designated by single or repeated motions of either of two indicators (right and left hand), or of both in conjunction. Thus the letter A which is placed opposite to fig. 1 is indicated by one motion of one left-ha
cator; the letter B which comes opp
fig. 2 by two motions of the same in
the letter E by four motions, two
two right; and so on.

FOURTH CLAIM.

"We claim, as an improvement in
telegraphs, the working *two* indicato
to give the requisite motions by mea
single handle constructed and arra
described."

FIFTH CLAIM.

"We claim, as an improvement
tric telegraphs for giving audible sig
use of a ring or piece of metal,
magnetized in combination with a
coil of wire, as above described,
and wherein the electric current so
the motions take place in a directio
verse to the axis of the coil, and par
nearly so, to the planes in which t
constituting the coil, lies, and actu
able apparatus for giving such audi
nals."

A bell or gong is substituted for t
plate and indicators, and the signals e
by striking one, two, or more su
blows on the bell or gong, which is
by wheelwork, for which no separat
is made.

SIXTH CLAIM.

"We claim, as an improvement
tric telegraphs, the use of an appar
conducting the atmospheric electricit
earth, in which the two semi-sphere
lightning-conductor, as usually con
for that purpose, may be adjuste
from each other, as circumstances
quire."

In lightning-conductors, as or
constructed, there are two metal pla
A, A′), which are fixed to and kep
by blocks of ivory, and two semi-
(c and c'), which are made fast, one
plate. The improvement here con
making the semi-sphere c fast to t
A (as usual), but attaching the oth
screw to the plate A′, "by which mea
by the aid of a regulating screw
semi-sphere of metal may be brough
closer or farther distant from th
sphere c, as may be rendered neces
the expansion or contraction of the
ment, or other circumstances."

SEVENTH CLAIM.

laim, as an improvement in elec- raphs, the insulator, and stretching g circuit wires upon and by means ilator, bell-shaped in the interior, revent the rain establishing a cir- e electricity from the wire to the pon which the insulator is affixed, iped on the exterior as to admit tcher, constructed as described, lied at pleasure, to stretch the uit wires from insulator to insu-

nsulators are to be made of glass, re, porcelain, or metal.

EIGHTH CLAIM.

laim, as an improvement in electric , a deflector, constructed and ar- described, in combination with an e to each instrument, whereby the urrent may be diverted, and the its insulated in such manner as to nstruments at two or more stations ; line to communicate with each ependently of the other stations."

NINTH CLAIM.

laim, as an improvement in electric , the use of the apparatus called lraulic battery," in which the acid d, or other retainer of moisture, is from above, drop by drop, and rom below, drop by drop, so as keep up continuously a percolation he sand, or other retainer of mois- , by such percolation, carry off the of zinc, and prevent its becoming ed on the plate; and we claim the aulic battery, both as an improve- the working of electric telegraphs, pplicable to the working of time- r clocks, where electricity is em- s a motive power, and for other in which a steady uniform current ic electricity is required."

battery we have already published tion, vol. xlvii., p. 523.

TENTH CLAIM.

claim for time-keepers, in which y is a moving power, the use of a iece of metal, partially magnetized, in combination with a reel or coil of wire, as above described, whereby and wherein the electric current so acts that the motions take place in a direction transverse to the axis of the coil, and parallel, or nearly so, to the planes in which the wire, constituting the coil, lies, and are adapted to suitable apparatus for measuring and indicating time."

As electric time-keepers require but a small power for keeping their pendulums in motion, "a sufficient current may be obtained from two series of any one kind of metal, (for which purpose zinc or iron is the most economical,) buried in the earth;" and "when zinc is used for the series, the supply of electricity may be augmented by surrounding one set of the plates of the series so employed with a solution of ammonia."

Of the precise meaning to be affixed to the term "partially magnetized ring," used throughout this specification, no explanation is anywhere given.

THE BREAK OF GAUGE QUESTION.

Mr. R. Stephenson has published this week a well-timed pamphlet on this subject, which deserves and will command universal attention.* All the world is aware that, through the meretricious striving after novelty, for the mere novelty's sake, of a very clever, but most pertinacious and somewhat unscrupulous gentleman, the right (or *Western*) limb of our vast railway system has been thrown sadly out of joint; and many may be aware also, that Mr. Brunel has proposed to mend the broken joint by a mixed system of broad and narrow gauges. The object of Mr. Stephenson's present "Observations" is, to show that the remedy is even worse than the disease. He does this with a degree of ability, and with an amount of practical knowledge brought in aid of it, which is absolutely overwhelming. Not all the *seven* champions of Christendom could help Mr. Brunel out of the abyss into which his *seven* feet folly has plunged him.

* The Double Gauge. Observations by Mr. Robt. Stephenson on Mr. Brunel's Report on the Double Gauge. Stewart and Murray. 28 pp. 4to, with numerous plates.

We once thought that the break of gauge might be remedied by some such plan as that of Mr. Henson, noticed in a recent No. of our journal; but we now see that there are objections to it, which neither that nor any other plan can obviate. We allude more particularly to the *break in the buffers*, which is a necessary consequence of the *break in the gauge:*

"Common sidings for both gauges could only be used alternately for vehicles of the one gauge or the other, not for both at one time; but if once such sidings were laid down, there could be no security against their being used for both kinds of stock at the same time: it is therefore necessary clearly to point out the danger which would arise from such a practice.

"This danger will be readily appreciated by any one who has stood by and observed a carriage at a station come into contact with another, while a porter stands perfectly secure between the buffers, the carriage bodies being prevented by the projection of the buffers from approaching so close as to crush him.

"By reference to drawing (No. 10), it will be seen that the carriages of the ordinary construction, narrow and broad gauge, when standing together on a common three-rail siding, will not buff together, the buffers missing each other, and coming in contact instead with the opposite carriage-frames. It is unreasonable to expect that a porter shall always, in the hurry of business, be able to consider whether an approaching carriage is narrow or broad gauge, and, consequently, whether he is safe or not if engaged in the siding: at any rate, no such danger should be thrust upon him by defective arrangements. To render a three-rail common siding safe, it would then be necessary to alter the buffers of the entire stock of the whole connected system of railways, using such siding in such way, that the narrow and broad carriages should buff together; for when once a number of railways are connected into one system, the stock finds its way to every part of the system at one time or other; indeed, it is the very object of the proposed mixture of gauges, that goods and passengers may proceed to their destination without change of vehicles; narrow or broad gauge vehicles must be everywhere in turn, as the traffic demands; and, until all of them are made to buff indiscriminately together, there can be no safety for porters in a three-rail siding. Accidents of this nature occurred from the use of stock not buffing together on the Glasgow and Greenock Railway until the remedy was applied: within a short period, several persons were injured, some fatally.

"Besides the danger to the men, it is clear that the buffers of every carriage (whenever two of different gauges come together) striking the cross framing of the other carriage, instead of the longitudinal framing or buffer ends, would knock the carriages to pieces; one or two blows of this nature, indeed, would, in all probability, so shake the framing of a carriage as to make it unsafe."

We should be disposed to compassionate Mr. Brunel under the severe infliction of this pamphlet, could we dismiss from our recollection the exceeding presumption and conceit which are at the bottom of his deviation from the standard system, and the enormous expense which it has entailed on his too confiding employers and on the public at large. We have been told by a friend of Mr. Brunel's, that he was first induced to think of the 7 feet gauge from the ease which he felt in riding in the state coach of a petty German potentate, which was some seven feet between the wheels! Lucky for the nation that the distance was not seventeen! We rather incline, however, to another authority, according to which, the Great Western Railway was made of the seven feet gauge because it was originally intended that its metropolitan terminus should be the "Seven Dials!" And taking that view of the case, we cannot help recognizing another marvellous turn of good luck in regard to this gauge affair; for had Mr. Brunel only been the engineer of the South Western, instead of the Great Western Railway, we should, to a certainty, have had a *nine* feet gauge, because it would have led to a "*Nine*-Elms" terminus!

Seven or *nine*, no better reason can be assigned for the one number than the other; and though many considerations, and good ones, too, have been suggested for a little exceeding the 4 feet 8½ inches standard (which, by the way, is just as empirical as any other, and has nothing but use and wont in its favour), in order to give more boiler and engine room, there has, to this hour, been no reason worth a jot, offered for selecting 7 feet as the only proper width, any more than 5, or 5½, or 6, or 6½, or 7, or 7½, or 8, or any other conceivable number.

PORTABLE CANNON.

The American papers make mention of a new sort of cannon, invented by a Mr. Fitzgerald, which is so constructed that it may be carried by hand or on horseback over mountains, forests, or marshes, where an ordinary cannon would be altogether useless. It consists of a series of circular perforated plates of the best wrought iron, 1-4 to 1-2 inch thick, with well planished faces, which are arranged in contact, and are connected together by wrought iron rods or bolts, passing through holes near the periphery; the bolts having strong heads at one end, and a screw nut at the other, whereby the plates are firmly held together. Several of the plates at the breach are, of course, solid, and without the hole in the centre. The series being thus connected, they are bored and polished inside, and turned off to the proper shape outside. While this cannon is stronger than those of common cast iron, it can readily be dissected, and each section may be shouldered by either pedestrian or equestrian artillerists, and when required, the parts may be put together and secured ready for action in ten minutes.

ELECTRIC CHRONOMETERS.

Electric Telegraphic Company,
Clock Department,
142, Strand, London, and
11, Hanover-street, Edinburgh.
August 19, 1847.

Sir,—Observing in your Journal of Saturday, August 14, a letter signed "Mechanicus" upon the subject of electric chronometers, I beg to inform the writer that this company have for some time been engaged in experiments to accomplish this object, and with every appearance of success.

A chronometer upon this principle, which will never require winding up, would be most invaluable, and by taking the electric current from the sea, which is easily done, a power would be obtained which we have reason to believe can be adjusted with the greatest nicety.

The fact of a vessel not being always at sea is of no moment, for the mere moisture from the sand or mud upon which she must necessarily rest, if not quite afloat, would be sufficient to keep up the electro-magnetic action.

The problem, however, will shortly be solved by a trial, the only true method of proving the theory; in the meantime, Mr. Editor, should you, your correspondent, or friends, feel disposed to pay a visit to the Company's office, No. 142, Strand, I shall be happy to show you a great variety of electric clocks, most accurate time-keepers, and explain the principle upon which they are constructed.

I am, Sir, yours, &c.
JOHN KYMER, Jun.,
Secretary.

CALENDAR OF SPECIFICATIONS OF PATENTS OF INVENTIONS. FROM THE PERIOD WHEN THE PRACTICE OF ENROLMENT COMMENCED TO THE PRESENT TIME.—CONTINUED FROM P. 166.

[From the Reports of the Deputy-Keeper of the Public Records (Sir Francis Palgrave).]

THE CALENDAR.

[Of the two dates annexed to each entry, the first is the date of the patent, and the second that of the enrolment of the specification.]

John Crang Hancock, of Wych-street, in the parish of St. Clement Danes, (Middlesex), organ builder: of an invention of a new grand pianoforte, with spring key touch, German flute and harp. Cl. R., 30 Geo. 3, p. 4, No. 7. April 13, 30 Geo. 3; May 10, 30 Geo. 3, 1790.

James Rumsey, of St. Margaret (Middlesex), engineer: of "new and improved certain methods of applying the power of water, of air, and of steam, either separately or together, as circumstances may require, to the purposes of milling and giving useful motion or effects to various kinds of machines, and for the advantageous management of shipping and vessels of all descriptions used in and upon water of all kinds in various circumstances and situations." (Several of the machines or engines in this specification are improvements on others of the same nature invented by the specifier, for which a patent was obtained 6th Nov. 1788, and the specification thereof was enrolled 6th Dec. in the same year.) Cl. R., 30 Geo. 3, p. 4, No. 3. March 24, 30 Geo. 3; May 22, 30 Geo. 3, 1790.

Estienne Leguin, of New Compton-street, of St. Giles-in-the-Fields, optician: of an invention of making certain machines or instruments which will not only save much time and trouble in calculating the Longitude, but be less liable to err than any of the methods now in use. Cl. R., 30 Geo. 3, p. 4, No. 1. June 1, 30 Geo. 3; June 30, 1790.

William Roberts, of High-street, Bristol, linen draper, and *William Dight*, of the same place, painter: of an invention, art, or mystery of running or laying paint mixed and prepared, with oil and other materials, commonly called Oil Colours, one upon another in thin layers upon canvas, wood, iron, stone, or any substance of that kind, in a way not as yet known in practice [and in such a way as to preserve their transparency].

Cl. R., 30 Geo. 3, p. 5, No. 13. May 11, 30 Geo. 3; May 29, 1790.

Roger Wearn, of Phillack, Cornwall, bricklayer: of a certain new invented method of heating the boilers of steam engines with a smaller quantity of fuel than is now used for that purpose, and also by the fire used in such boilers to calcine ores at the same time. Cl. R., 30 Geo. 3, p. 5, No. 1. July 8, 30 Geo. 3; July 27, 1790.

Robert Barclay, of Southwark, brewer: of a method of making punches for stamping and punching the matrices of printing types for letters and devices, and for impressing on copper cuts or other printing plates, and on dies, and on various metals, and on any other substances, certain marks; which letters, devices, and marks cannot be counterfeited. Cl. R., 30 Geo. 3, p. 6, No. 7. July 26, last past, 30 Geo. 3; Aug. 17, 30 Geo. 3, 1790.

Charles Earl Stanhope: of an improved method of moving ships and vessels against wind, waves, current, or tide, or against the power of them all united. Cl. R., 30 Geo. 3, p. 7, No. 2. Aug. 17, 30 Geo. 3; Nov. 1, 1790.

Johanna Hempel, of King's-road, Chelsea, potter: of an invention of a certain composition made of earth and other materials, and the means of manufacturing the same into basons and other vessels, which so manufactured hath the power of filtering water and other liquids in a more cheap, easy, and convenient manner than water or other liquids can now be filtered. Cl. R., 30 Geo. 3, p. 8, No. 8. Oct. 16, 30 Geo. 3; Nov. 13, 1790.

George Singleton, of Featherstone-street, Middlesex, calico glazier: of certain alterations, improvements, and additions in, about, and to the old machine for glazing of linens, cottons, calicoes, muslins, stuffs of linen, and cotton buckrams, and various other articles of British manufacture, as well as those of India. Cl. R., 30 Geo. 3, p. 8, No. 3. Nov. 6, last past; Dec. 4, 1790.

Thomas Nightingale, of Milk-street, London, calenderer: of a machine for calendering, glazing, and dressing of muslin, calico, cotton, linen, woollen, silks, paper, gauze, mohair, and other articles, in a superior manner to any which have heretofore been used or discovered. Cl. R., 30 Geo. 3, p. 8, No. 1. Nov. 16, 31 Geo. 3; Dec. 14, 31 Geo. 3, 1790.

Richard Law, of Birmingham, plater: of an improved method of making shoebuckles and chapes. Cl. R., 30 Geo. 3, p. 11, No. 18. Jan. 23, 30 Geo. 3; Feb. 17, 30 Geo. 3, 1790.

Samuel Hands, of Birmingham, bucklemaker: of a new invented method of ornamenting all kinds of buckles, coaches, chaises, phaetons, harne accoutrements of leather or paper man or horse (with gold, silver, and metals, glass, pearl, ivory, and otl stance whatever). Cl. R., 30 Geo. No. 11. Feb. 23, 30 Geo. 3; March 1

William Morecroft, of Litchfiel tect: of an invention of a new me crane or machine for the purpose o and shifting of weights of different tions or kinds. Cl. R., 30 Geo. 3 No. 1. July 8, 30 Geo. 3; Aug.

Matthew Boulton, of Soho, Staf gineer: of certain new methods of the powers of water mills, cattle m steam-engines, either simply or co with the pressure of the atmosph with weights and springs to the wo fly presses, or stamps, such as a monly used for the purpose of sti making impressions upon buttons, or other pieces of metal, as well u dies, or medals, or coins, and als working of presses for cutting ou for any of the above purposes. C Geo. 3; p. 14, No. 2. July 8, 30 Aug. 5, 1790.

(*To be continued.*)

NOTES AND NOTICES.

A Wire Suspension Bridge is now ere the Ohio, which will be the largest struct kind in the world, having a span of u 1,000 feet, whereas, that of Fribourg is feet.

Natural Compass.—In the vast prairies a little plant is always to be found, wh every circumstance of climate or chan ther, invariably turns its leaves and flow North.

The highest fountain in the world grounds of the Duke of Devonshire, whe jet is thrown up to a height of 267 f than 100 feet higher than Niagara Falls.

A Large Raft.—A raft, from Canada, *dred feet* in length, 39 feet in width, an 3 feet water, was towed into Buffalo. Th composed of spars and pine saw logs, u was 170,000 feet of sawed pine lumber.

New Cluster of Stars.—The *Cincinnati* July 10, states that Professor Mitchell has a new cluster of stars, one thousand in r which he has given the name of "Becchoi appearance is singular. They are of a blue emit an unsteady light. They seem to re spiral orbit

Daguerreotyping Lightning.—The *St. velle* says that an artist in that city has peated experiments, actually succeeded i reotyping a *streak of Lightning*. "So p instantaneous was the operation that intervening drops of rain were transf wonderful distinctness to the plate, eve taining its globular form, showing that ciable space of time was consumed in tion."

Baby Jumpers!—The Philadelphians a state of excitement, respecting certain ne ed articles thus named. They describe one "Imagine a cord fastened to the ceiling, diverging into several cords, which are fa child's frock by attachments to the belt.

is elastic, and the child being attached to it, may be left to itself and will find its own amusement in the constant jumping up and down and about, which its movements occasion.

Messrs. Sibley and Rutherford's Earthwork Tables.—We find that we were in error in supposing Mr. Rutherford's colleague in the production of these tables to be Mr. Sibley of Great Ormond-street, the member of the Council of Civil Engineers. Our error, however, consisted but in the substitution of father for son; the real author being Mr. Charles Sibley, who was educated and took high honours at Addiscombe, went afterwards to India, returned to England on account of his health, and is now one of the resident engineers of the Sheffield and Lincolnshire Railway. We knew of Mr. C. Sibley's departure for India, but had not heard of his return to England, and hence our mistake.

WEEKLY LIST OF NEW ENGLISH PATENTS.

[No patents sealed between August 14, and August 21.]

LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED UNDER 6 AND 7 VIC. CAP. 65.

Date of Registration.	No. in the Register.	Proprietors' Names.	Address.	Subject of Design.
Aug. 13	1165	Joseph Salt	Uxbridge	An improved expanding die for making articles moulded in clay.
14	1166	John Talbot Ashenhurst	Upper John-street Fitzroy-square	Improved folding and reading desk.
17	1167	S. Mordan and Co.........	City-road	Spiral spring inkstand top.
18	1168	Richard Fred. Bickerton	Castle-street, Southwark	Ventilator for hats, &c.

Advertisements.

CONTENTS OF THIS NUMB

NOTICES TO CORRESPONDE

J. E.—Received and under considerat further paper offered would be acceptable.

G. E. D.—No "appropriate covers" ar otherwise they should have been cheerfull

Communications received from Vulcan Bell—Mr. Ranwell—W. R. S.—Utilitas Mr. Currie.

LONDON: Edited, Printed, and Publ Joseph Clinton Robertson, of No. 1 street, in the City of London.—Sold W. Galignani, Rue Vivienne, Paris; M Co., Dublin; W. C. Campbell and Co., H

Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 1255.] SATURDAY, AUGUST 28. [Price 3*d.*

Edited by J. C. Robertson, 166 Fleet-street.

WRIGG'S PATENT SELF-CARRYING RAILWAY CARRIAGE, FOR COMMON ROADS, FIELDS, &c.

Fig. 1.

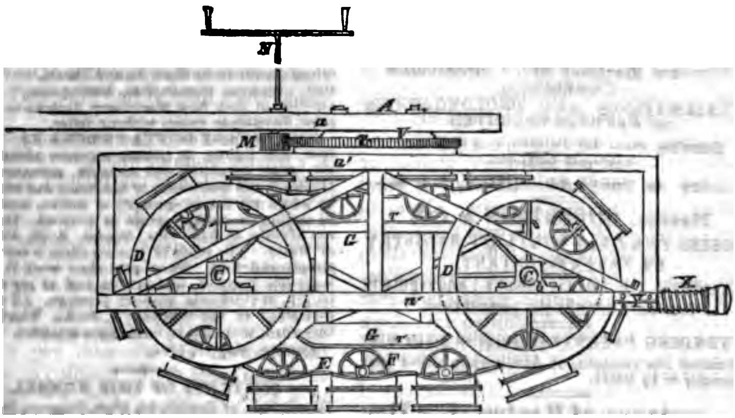


Fig. 1ᵃ.

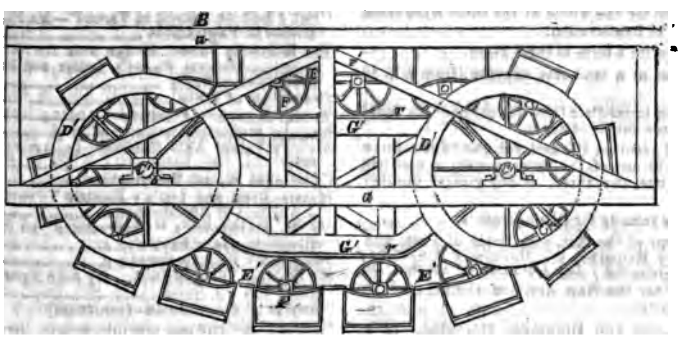
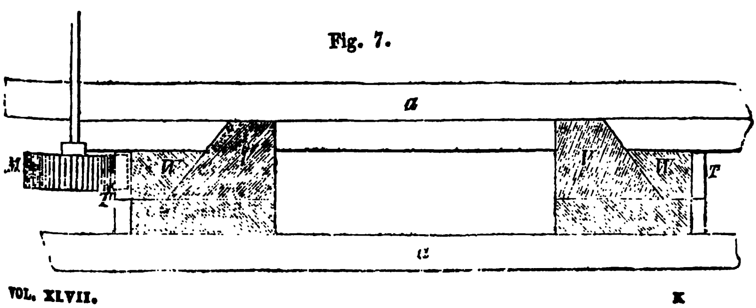


Fig. 7.



WRIGG'S PATENT SELF-CARRYING RAILWAY CARRIAGE, FOR COMMON ROADS, FIELDS, ETC.

MR. WRIGG describes his invention as consisting generally in diminishing draught and friction in carriages and other conveyances, by constructing every description of carriage in such manner, and providing it with such appendages and appliances that its weight shall always be borne by rails attached to the carriage, and *resting or moving on one or more of an endless chain of friction wheels* caused to revolve by the traction or propulsion of the carriage in a longitudinal direction; and this, whether such carriage move on prepared or unprepared ground, and whether it is propelled by animal or steam, or any other power. Several other plans having the same object in view have been at different times proposed, but Mr. Wrigg's differs from them all (according to the best of our recollection) in this essential particular—that his carriage by its revolution lays down an endless series of friction rollers, and then upon these rollers an endless series of rails, which last support the weight of the carriage, whilst in the other plans to which we have referred, the rails bear directy on the ground.

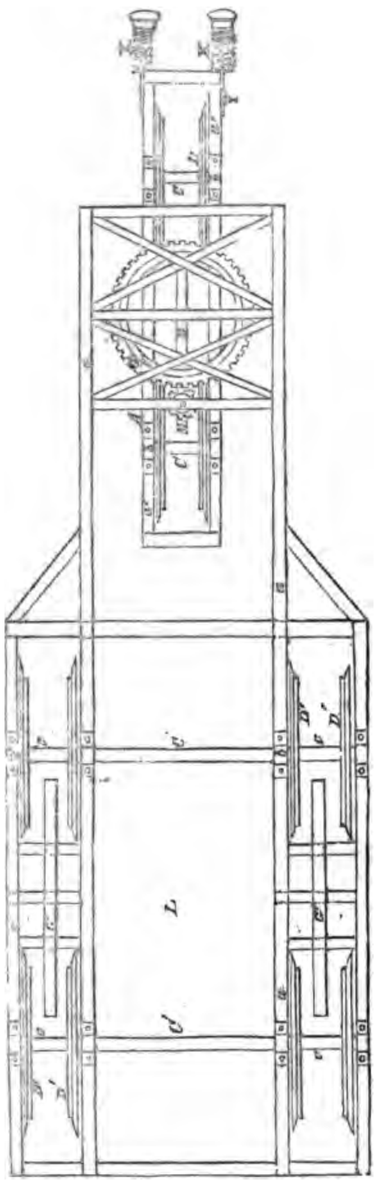
Fig. 1 and fig. 1^a of the accompanying engravings represents a side elevation of a carriage, constructed, according to Mr. Wrigg's plan, to be propelled by steam—Figure 1^a being supposed to be a continuation longitudinally of figure 1. Fig. 2 is a plan. (In both figures some of the less material parts are for the sake of greater clearness omitted.)

The carriage consists of two distinct bodies, A and B, connected by one common frame work *a a;* the front body A serving to guide the carriage, and the hind body to carry the passengers or goods as also the steam machinery by which the whole is to be propelled. Each body is provided with its own separate rails and friction-wheels. The machinery peculiar to the front body A, is sustained by a separate framework a^1 a^1. C C are solid cranked axles, which revolve in brasses *b b*, and D D are deeply flanged tumblers made fast to hollow axles which encircle the solid axles C C. E E are links of the endless chain, or series of railway friction-wheels F F, which, with their pedestals P P, revolve round the tumblers D D; and G G is a frame fixed between the tumblers to which the stationary rails *r r*, are attached, and which may be either flanged or plain. A side elevation of one of the axles C C, and transverse of one of the tumblers D D, are gi rately on an enlarged scale in figu is the cranked axle, and *c* the ho which encircles it. D is the tumb is firmly attached to the hollow ax are the flanges; *f* is a clutch, by w hollow axle *c* may be made fast to tached from the solid axle C at p *g g* are tappets attached to the tur such positions, that as the tumbler they catch into the links E E of th chain, which links fit into the space the flanges *d d*, and rest upon the *e e*. On one side of the inner flang is a friction-drum *h*, which is in c with, or attached to the tumbler D volves with it.

From this drum a belt is carr lever which is under the contro conductor of the carriage, so th the tumbler is freed from the m C, by the application of the clutc conductor can, by acting on the friction-drum as aforesaid, very check the speed of the tumbler, or to a state of rest. A plan, side e and section of one of the friction-w with its pedestal P, and other app are given separately on an enlarged figures 4, 5, and 6. The pedestal P of an open square box of wood *k k*, horizontally into two portions as p explained) raised on a circular b which is also of wood, but is s iron, a layer of felt, *i i*, being in between the wood and iron to de sound of the machinery when in The axle *n*, of the friction-wheel in brass bearings *o o*, screwed to tw sides of the box at top, and the w volves partly within the box. The divided horizontally into two por aforesaid, in order that the upper may in the course of the revolution wheels be turned round before th has deviated from a horizontal positi this is effected by the interventio three metal pieces *p*, *q*, *s*. The first annular plate of iron, which is mad the top of the under portion of t and projects considerably at the fou The second (*q*) is a similar annular brass, but of less diameter, and cons projecting less at the sides, which i fast to the bottom of the upper po the box. These two plates mov round upon one another, and ar therefore, as smooth as may be on t faces which come in contact. Th phery of the plate *q* is bevilled outw

he third piece s, is a ring of iron s on, and is secured to the plate evilled inwards on the inside, so respond with, and overlap the dge of the plate q. The result rangement is, that as each pe- es to the turning point in the its revolution round the drums, art first moves very equably and und, and then brings the lower it by means of the overlapping of the ring s. The hinder body arriage (see figures 1 and 2) is in cts a counterpart in double of the A; that is to say, it has solid les C′ C′, similar to C C, but of ength, and tumblers D′ D′, simi- tumblers D D, but attached in he axles C′ C′, one at each end, fixed to, or turning loosely on ; two endless chains of friction l pedestals F′ F′, and P′ P′, simi- and P P (excepting only that the re not divided, but in one piece); xed sets of rails G′ G′, similar to h rest or move on the two series -wheels F′ F′. The carriage is in ur-wheeled one, with two guide aced end to end) in front. The ce L may be appropriated to the ation of passengers or goods; or age is not designed to afford such ation, but to be employed in r propelling passenger and goods he space (L) may be occupied by n-engine, or other motive agent M, N, T, V and W, are the the machinery by which the two he carriage A and B are made to unison. M is a pinion affixed to side of one of the cross pieces of a a, which is common to both A axis of which pinion is prolonged hrough the cross piece, and ter- n a hand lever N. T is a cog ed to the top of the framework a' e part A into which the pinion M V is a circular ring bevilled out- ich fits into a corresponding bevil aised on the top face of the cog d is made fast at top to the com- e a a (see sectional view of these re 7), whereby the two frames a a and through them the two parts A he carriage, are immovably connect- r; while at the same time, the fore left free to turn in any direction. buffers, which act against spiral oiled round their respective shafts, fts play into sockets Y Y, attached des of the frame. From the pre- scription, the manner in which pro- is given to the carriage will be rea- stood. Previous to starting, some of the pedestals of each chain of friction-wheels are resting on the ground, while all the rest are wound round the tumblers; and the

Fig. 2.



entire weight of the carriage is sustained by such of the friction-wheels only as are in direct contact with the rails. It is desirable

in the case of the fore part A that there should not be more than one wheel in con-

tact with the rails at a time, in this, which is the guiding part of

Fig. 4.

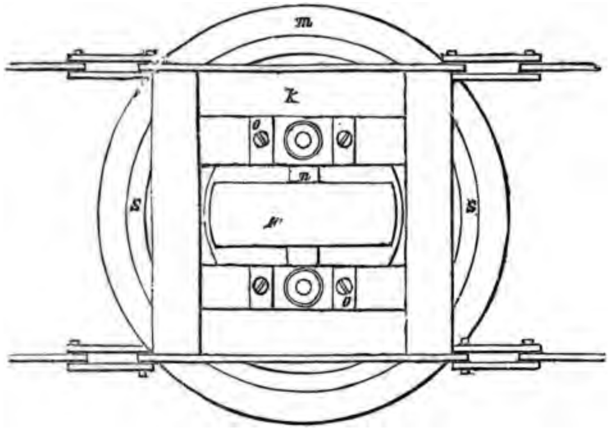
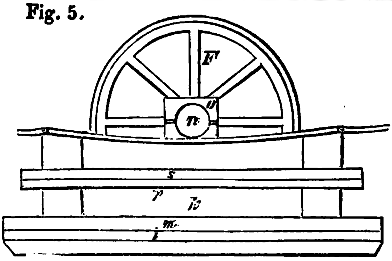


Fig. 5.



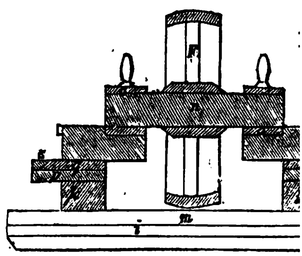


Fig. 3.

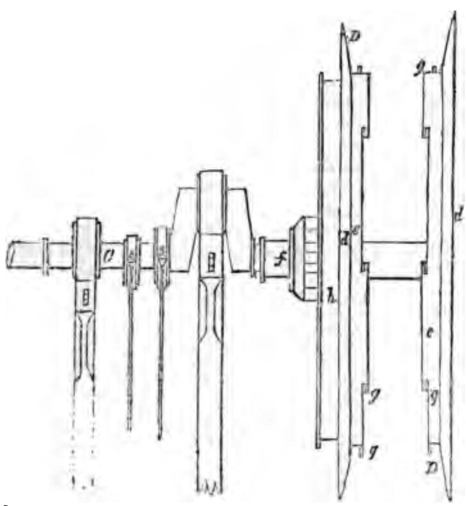
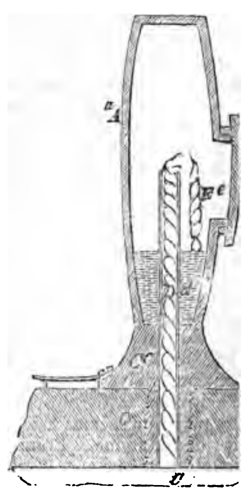


Fig. 8.



cle, may turn with as much ease as possible; *and, with this view,* the rails are made

short, and rounded off at the end, in fig. 1; but in the case of the

B, it is immaterial how many of the wheels may be in contact with the rails. When a rotary motion is given to the main axles C and C′ (by animate or inanimate power), and thereby to the tumblers D and D′, the carriage slides forward by means of the rails attached to it on the friction-wheels beneath; while, simultaneously therewith, a revolving motion is imparted to each of the endless chains of wheels, which brings one wheel after another in continual succession under the rails, producing thus all the effect of one continuous rail. The axles C and C′ of the tumblers D and D′ are represented in the drawings as turning in circular bearings; but where the carriage is intended to be used on very rough ground, it will be desirable to substitute slotted bearings, so that the tumblers may give way to a small extent upwards, and the carriage be thus more easily carried over any obstacle which it may encounter. Instead, also, of the pedestals being, as represented in the drawings, united by metal links, they may be united by pieces of leather, or other like flexible material; and, in either case, should the carriage be much exposed to dust or dirt, it may be proper to fill up the spaces between each pair of pedestals with a piece of leather or cloth, of the width of the pedestals, in order to catch such dust or dirt, and prevent its falling on the interior parts of the machinery on the pedestals becoming inverted.

When animal power is employed to draw the carriage, the fore or guiding part A may be dispensed with.

The oiling of the axles is effected by an oil-box of a peculiar construction, one such box being attached to the brass bearing of each axle. A sectional elevation of this box is given in fig. 8. A^a is the box, which is filled with oil to about the height shown. B^b is a lid, which is screwed on to a ring which projects from the side of the box. C^c, neck by which the box is screwed into the brass bearing o. D^d, a tube, which is passed down through the neck C^c to the axle C, and carried upwards a little way above the level of the oil in the box. E^e some threads of cotton, which, being inserted at one end into the tube D^d, and dipping at the other end into the oil, supply, by capillary attraction, a constant flow of the oil to the axle. F^f, a circular rack, raised on the top of the brass bearing, and secured to the neck of the oil-cup, which takes into the rack F^f, and holds the box fast when screwed into its place. The advantage of this oil-box is, that no supply of oil can be given to the axle except when the box is nearly vertical, and that there can be no escape of the oil except in the direction of the axle.

REMARKS ON THE USE OF MATHEMATICAL KNOWLEDGE TO ENGINEERS, AND HINTS TO THOSE WHO HAVE NOT THE BENEFIT OF A TUTOR.

(Continued from page 34.)

Although it has been thought better to give an independent proof of the equation of vis viva, rather than found it on that of virtual velocities, the connection between the two is so great that one may be easily derived from the other. The following is one way amongst others by which we may derive the equation of virtual velocities from that of vis viva.

It must be remembered that, in the equation

$$mv^2 + m'v'^2 + m''v''^2 + \&c. = 2\left(\int Pdp + \int P'dp' + \int P''dp'' + \&c.\right)$$

the velocities v, v', &c., are the velocities generated since the instant that the forces P, P′, P″, &c., began to act upon the system: care must be taken therefore with regard to the limits of integration on the second side, so that if at any given instant the velocities be (v_1), (v'_1), &c., and the corresponding forces P_1, P'_1, &c., and at another instant afterwards the corresponding quantities be (v_2), (v_2'), &c., P_2, P_2', &c., the equation will be

$$m(v_2^2 - v_1^2) + m'.(v'^2_2 - v'^2_1) + \&c. = 2\left(\int_{P_1}^{P_2} Pdp + \int_{P_1'}^{P_2'} P'dp' + \&c.\right)$$

Suppose now any system of rigidly connected particles to be in motion, and that the first of the preceding equations expresses the relation between the velocities of the different points and the forces which have acted upon them up to that instant, at which the values of those forces are P, P′, &c. During the next instant the increment of velocity and force will be expressed by the relation,

$$m(.v.dv) + m'.(v'dv') + \&c. = Pdp + P'dp' + \&c.,$$

where (dp) is the space described by the points of application of P in its own direction; and so of the rest.

Now suppose that at the beginning of the instant we are considering, the various acting forces are so related that from that moment the velocities (v), (v'), &c., become *uniform:* the motion of the whole system therefore at this instant is perfectly unaltered by the forces then acting on it: in other words, these forces are such that they mutually destroy each other's effect, and if the system were at rest, *would keep it at rest.* Hence at this instant we have, (since $dv=0$, $dv'=0$, &c., the velocities being at that instant uniform),

$$0 = \mathrm{P}dp + \mathrm{P}'dp' + \&c.$$

which is the equation of virtual velocities.

If at the instant we are considering the whole vis viva is a maximum or minimum (*i. e.*, as depending on the forces), in either case $dv=0$, $dv'=0$, &c., and the position at that moment is one in which the forces tend to keep the system at rest. "It is usual to distinguish between these cases as positions of stable or unstable equilibrium; but I suspect there is a fallacy in the reasoning, and, at any rate, we can only conclude anything for displacement of the system which *actually* occur in the motion itself: so that we are not authorized in supposing these to be the same as the ordinary *statical* positions of stable or unstable equilibrium. The question, however, is one of very little practical importance. It is also sometimes assumed that if the differential coefficient of the whole vis viva is zero, the vis viva itself is a maximum or minimum. With regard to this, Professor De Morgan has remarked, in his *Differential and Integral Calculus*, that 'The assumption that A is a maximum or minimum when $d\mathrm{A}=o$, has occasioned many errors, and the greatest writers have their full share of them.'"

By the proof given in a preceding article, the equation of vis viva will be seen to be applicable to all motions of particles, during which the particles acting on one another *remain at the same distance.* It is therefore at once applicable to the motion of incompressible fluids, and indeed was taken as the basis of the first analytical Treatise on Hydronamics published — viz., that of Dan noulli.

His father, John Bernoulli· the most quarelsome old men t lived, who was always squabb his brother James whilst he w and with all and sundry afterw sooner sees his son Daniel seiz and making use of this princi which, as being his mathemat geny, he entertained still more than for his less abstract offspr with a sort of feeling of "no on my manor, if you please,' thinks himself how he is to av injury. It will be seen that gentleman was in somewhat of dary, for he could not deny the ness of the principle, inasmu himself had been its chief au nourisher. And yet he was loath that his son Daniel had made m than his father had manage Still, to be outdone by Dani never do—so he sets him to w writes a new treatise on the sa ject, and in the preface does to make you understand that was good and true in Dan's depending on this vis viva (" *atque a me demonstrato*") mu down to the credit of the fathe the same time that Daniel's being an indirect one, and mo neglecting to take into accou tain "gurges" or "whirlpool he, the father, had discovered *non animadversum*")—must alto a very inferior performance i that with which he himself is favour you.

The old gentleman finds it ea ever to get himself and his rea this newly-discovered whirlpo out of it again.

With regard to the motions media, the question as to the app of the equation of vis viva is m cate, and at the same time of able importance. In all cases v vibrating particles of the medi tiguous to one another, undergo the same motions, and at the en given time return to their origina the equation evidently holds go proof given above shows. For t between them is equal and opp by supposition, the spaces throu it acts are the same for the two

e have, as in the undulating light, to investigate what takes the confines of two different hough we are certain that the rce is the same for both, we) means sure that the spaces which that force acts are the oth; and, moreover, the forces the particle in the denser me- not the same as those on the 1 the rarer medium; so that, they return to their original one may have gone over a iter space than the other. This on, however, which as yet has 1 thoroughly examined.

tory of this vis viva is altoge- us. For a history of the dis- cted with it, which lasted about s, and set almost everybody in ribbling about it, the reader to *Whewell's Hist. Inductive* vol. ii. Leibnitz commenced it r in the *Acta Eruditorum*— demonstration of a memorable escartes and others concerning l law, by which they think that 's preserves the same quantity ; in which they pervert me- The strange way in which maticians of those days thought ason, or rather to write about , is often not a little amusing. best of them talk very queerly: e, John Bernoulli has a paper, *Notione Virium Vivarum*, in says, "Vis viva does not con- *ual exertion*, but in the *faculty of acting;* for it exists, even do not act, and has nothing to ' "Hence it appears," says ther place, "that this vis viva ng *real and substantial*, which er se, and, as far as in it lies, is lent upon any body"—"quan- est non dependet ab alio." It refore, appear to be a substan- endent gentleman, "living on "—none of your flimsy mathe- bstractions. As I have said, had a hand in the dispute—a narchioness amongst the rest, ed "Treatise on Fire." Vol- above all earthly men, must l a *Memoire* on the subject to emy. Now, what was all this *bout?* Why, if there *really real* dispute at all (which is ubtful, and always is in such cases), the point in question was this:— Whether the magnitude of a force should be *measured* by the velocity generated (in a given mass) in *a certain time*, or by the velocity generated in moving through *a certain space*. If in the time (t) a force produced in a mass (m) a velocity (v), then Newton had taken as the *measure* of that force the product mv; and those who considered themselves his partizans and defenders in the dispute alluded to, contended that this was the *only proper measure*. Leibnitz and his followers would have it that the only proper measure was the product mv^2, where (v) is the velocity produced or destroyed in moving through a given space (s). This they confirmed by citing the following experiments:—Balls projected horizontally against a wall of clay, or other resisting substance, penetrated to depths proportional to the squares of their velocities (the masses being the same). Also, bodies projected upwards, rise to heights proportional to the square of the velocity of projection. Now, the whole question is very easily decided by referring to those simple and self-evident principles by which we are necessarily guided in *estimating* or *measuring* any cause by certain of its effects. In comparing, therefore, one force with another, we are at perfect liberty to take *any* of the effects (as, for instance, the velocity produced), *provided all the rest of the circumstances are the same* in the two cases. The velocities produced, for example, will be correct measures of the force, provided they be produced in *equal times* in *equal masses*, all the other concommitant circumstances being also the same. Now, in the case of the balls fired upwards, or into the clay wall, this necessary condition of equality of circumstances was overlooked by most of the Leibnitzians, inasmuch as the ball which rose highest in the air, or sunk deepest in the clay, would take a *longer time* than the other. The one, for instance, being fired with a velocity (v), and penetrating a space (s), and the other with a velocity (v'), and penetrating a space (s'), if we denote by (f) the resisting force of the clay, or the retarding force of gravity, we have

$$v^2=2fs, \quad v'^2=2fs'. \quad v=ft \quad v'=ft'.$$

(t) and (t') being the times of motion in the two cases. Hence it is seen that, if the *space penetrated* be alone considered, and taken as the *measure* of the

force, then the square of the velocity is proportional to that quantity; but if, as we evidently ought to do, the *time* be also taken into account, then, measuring the force by the space described, directly, and the time employed, inversely

$$\frac{s}{t} = \frac{v}{2}, \frac{s^1}{t^1} = \frac{v^1}{2}.$$

I have said "some of the Leibnitzians" seem to have forgotten this necessary precaution; but John Bernoulli was perfectly aware of it, only he contended that any force ought to be measured by the *whole* effect produced, without any reference to the circumstances under which it was produced, and uses the queer illustration that, in estimating the quantity of water in a basin, we never think of how long it would take to fill it. The answer is easy. Though, in *measuring any one force without reference to, or comparison with any other*, we may properly take the whole effect so produced; yet, in comparing with others, we must have all the circumstances the same: and, to use his illustration, though, in measuring the work done by a person in filling the basin with water, we might take the quantity of water put in as a measure, if we had to compare this with the work done by another person in filling another basin, we must take into account *how long* each person took to do it. Or, to use another illustration, a man might carry a ball of iron as far as a cannon could fire it; and so we might say the *whole effect* of the two was the same, or the whole force expended in each case the same: yet, obviously, for all ordinary purposes of comparison, we must consider not only the work done, but *the time in which* it is done,—not only the whole effect produced, but the time in which it is produced.

There has been a curious sort of "metempsychosis," or transmigration of ideas into different forms, in this subject, from "work done" to "vis viva," and from "vis viva" to "work done."

Lagrange, in his *Mecanique Analytique*, states that Descartes "reduced the whole of statics to the principle, that it requires neither more nor less force to raise a weight to a certain height, than would be necessary to raise a greater weight to a height proportionably less, or a less weight to a height proportionably greater. Whence it results that there will be equilibrium betw weights when they are so conne the perpendicular paths which simultaneously describe are rec proportional to the weights. B application of this principle to machines, we must consider spaces described in the first i motion, and which are propoı the virtual velocities."—(tome i

Here then we have the sir natural idea of "work done," into the principle of virtual v which, again, has been made t dation of that of vis viva, fron again, in the last place, the notion of "work done" has bee in a form adapted to the calcu the effects of machinery.

With those modifications w change of conditions would re think it probable that in this would be found the best metho culating the relative efficiency paddle and screw—as by it a might be got between the qua water put in motion *uselessly* in cases.

(*To be continued.*)

BROWN'S DISINFECTING PROCES ARTIFICIAL MANURES.

[Patent dated 20th February, 1847. Sp enrolled 20th August, 1847.]

The present invention which to have been communicated to tentee from abroad, consists, fi neutralizing the odorous and gases emanating from fecal su or, as it is sometimes termed, the fecting" of such substances, whe may be collected and preserved, to their being manufactured into compounds applicable as manure out injury to the public health, individuals engaged in such c and manufacture; secondly, in ing the said fecal substances into compounds applicable as manur thirdly, in manufacturing carbo pounds from the muscular flesl and offal of dead animals, and t ammoniacal waste matters of var nufactories.

We extract the following detai invention, from the specification

The substances employed for pose of disinfecting are, either the of iron or the chlorides of sodium (or the chlorides of iron and manga

tes, sulphates, and chlorides of lead, zinc, and tin; or pyroligneous acid; rolignites of iron; or the mother-ising from the manufacture of any efore-enumerated substances; or or schistous and bituminous ex- Of these, preference is given to the and chlorides of iron. All of them used in a dilute state. When solu-ulphate of iron or chloride of iron oyed, they should be poured into ool, or other fecal receptacle in rtions of from one to two and a ns of the former, and from one to a half gallons of the latter for every s of the cubical contents of the or other receptacle. The mass hen be stirred, in order to effect ation of the salts with the matters nfected, after which some of the ab-owder hereinafter described should n in over the whole. The cesspool receptacle must then be closed for minutes, when the removal of the l may be commenced, without fear pleasant smell. The emptying of pool, or other receptacle may be either by means of an exhausting d hose (the matter being supposed a sufficiently liquid state), or by an endless chain of pails or buckets, in a case or hood, to conceal the from view. As the matter is taken turned over into casks, which, on ed, are closed up, and then removed anure) manufactory.

sorbent powder is then formed by bout 75 parts of coal or wood ashes h, or street or road sweepings, and parts of vegetable, animal, or mine-ish, such as saw-dust, bone-dust, se matters are incinerated to powder cting them, in closed vessels, to a ree of heat, so that the carbon con-the organic portions of the mixture blended, in a state of extreme divi-th the earthy portions, and impart to the whole a highly absorbent pro- Three different sorts of ovens or re employed to effect this incinera-he *first* consists of a brick or cast-r, covered over by an arched roof, in brickwork, in such manner that e and heated vapours of the furnace d all round it. In the roof there is or introducing the materials, and at om, on a level with the floor, there her, for withdrawing them. The ing filled, and the doors closed, it is to a dull red heat; and when the ls exhibit a very black appearance, withdrawn, and stored up in close in order that they may be preserved from contact with the humidity of the atmosphere. The *second* oven is but a modification of the first, differing from it in this only, that the floor is made to slope slightly, and that the materials are introduced through one or more inclined passages made in the roof. The *third* consists of an iron cylinder set in brickwork, and enclosing a revolving vertical shaft, with radial blades, by which the materials are cut up and mixed. The top of the cylinder is closed by means of two sliding plates which take into recesses made in the brickwork, and have apertures in the centre just sufficient to allow the revolving vertical shaft to pass through. When the oven has been filled and heated, a rotary motion is given to the agitator, by hand, or any other suitable mover. The cylinder terminates at bottom in an inclined passage, through which the materials, when fully incinerated, are removed.

The inventor prefers to use an absorbent powder thus prepared; but he states, that there may be substituted for it either common (chimney) soot, or any of the black residual matters of sugar and other refineries, or the black deposits resulting from the combustion of resinous and bituminous substances.

When the fecal matters which have been treated and barrelled as aforesaid, arrive at the manufactory, they are immediately converted into carbonic compounds applicable as manures, by one or other of the following processes:

In the case of very small villages, or hamlets, where the amount of produce will not warrant the incurring of any considerable expense for machinery, or otherwise, the casks or barrels are emptied into the first of a series of three inclined pits or basins of an elongated oblong form, composed of brick pointed with mortar, so as to be perfectly water-tight, and placed terracewise one above another; that is to say, the first on a higher level than the second, and the second on a higher level than the third; the three pits communicating with one another, by means of self-acting flood-gates. From the last of these pits any given quantity of the fecal matter is taken to what is called a "mixing basin," and there well mixed with from 15 to 20 per cent of the absorbent powder, prepared as aforesaid, or one or other of the substitutes for it before-mentioned, so that any adhering damp, or any gas which may be now disengaged, may be taken up or absorbed by the powder. The mixed materials are then taken from the "mixing basin" and spread out on platforms of baked earth, or on trays, to dry in the open air, and when fully dried they are again well pounded and packed up in casks ready for use. The

casks should be kept until removal in some close and dry place."

For cities, towns, and large villages, the following arrangements are adopted: The basins are each inclined as before, but they are made of a circular form, and placed on a line with one another, and from each basin there is a pipe for conducting any drainage or surplus liquid to a vaulted reservoir, common to the whole series, where it may be collected and applied to the manufacture of ammoniacal salts. Each basin is moreover furnished with an agitator, similar to that before described, worked by machinery, and it has at bottom a trap which opens into a passage constructed underneath the basin in the direction of its inclination. As the fecal matters, prepared as aforesaid, arrive at the manufactory, they are immediately thrown into these basins, and absorbent powder added in the proportion before directed. The agitators serve to mix the two matters intimately together, and as they are mixed they drop through the traps into the inclined passages underneath, from which they are removed in tilting carts to be dried as aforesaid. After drying, the carbonic compound thus formed is passed through a revolving cylinder composed either of perforated metal or metallic wire gauze, which is mounted in an inclined position, so that should there be any stones or other hard matters contained in the compound, they may roll to the bottom, and the finer portions only pass through the cylinder.

The mode of manufacturing carbonic compounds, applicable as manures, from the muscular flesh, blood, and offal of dead animals, and from the ammoniacal waste matters of various manufactories is as follows:

After the flesh has been skinned it is thrown into a copper filled with water, having a double or false bottom, which is pierced with holes. From eight to ten per cent. is added of sulphate of iron, chloride of iron, or any of the other salts or bases before named, or instead thereof, from 20 to 25 per cent. of common tan. The materials are then boiled until the flesh begins to be disintegrated, when the oil which has been formed is drawn off (from the space between the false and real bottom). The fleshy mass is then taken, out of the copper, and the bones separated from it; after which it is thrown into a hopper, from which it is passed between two grooved cylinders, to which a rotary movement is given by any suitable machinery. From these cylinders it comes away in the state of a thick jelly, which is either dried without any admixture, or after adding to it about 10 per cent. of the absorbent powder, which, without diminishing its strength, tends to retard considerably its decomposition. In some cases it will be sufficient to boil the flesh in pure water, and afterwards to immerse it for some time in any of the saline solutions aforesaid, or in cold tan liquor. When prepared by any of these modes the flesh dries without giving forth any repulsive smell, does not engender worms, and may be preserved for an unlimited time.

To preserve and convert into manure in like manner the blood and offal of slaughter-houses, much the same processes are followed as in the case of flesh. Either the fibrine and albumen of the blood are coagulated by boiling, or the materials are treated cold, mixed with some of the saline substances mentioned under the first head o this specification, and then about 25 per cent. of the absorbent powder added.

Excellent manures may also be obtained from the waste matters of various manufactories, which are rich in fertilizing principles, such, for example, as the waste from the manufactures of Prussian blue and prussiates, the ammoniacal waters of gas works, the waste of potash and soda works —in short, all remains or rubbish which abound in salts, or ammoniacal products. These waste matters are mixed with the absorbent powder, and used either alone or with the addition of a portion of the manure manufactured from animal remains.

MESSRS. DAVISON AND SYMINGTON'S PATENT DESICCATING PROCESSES.

We gave some account of these processes at the time when they were first patented (vol. xl., p. 338). We anticipated much good from them, and are pleased to learn that the public have not been slow in appreciating their merits. Already they have been successfully applied to not less than twelve different branches of trade,—brewing, distilling, bleaching, paper-making, feather-dressing, coffee-roasting, &c., and it would seem as if they must come ere long into universal use.

The reader may remember that the general principle on which these processes are founded is, the great desiccating property possessed by *rapid* currents of air of a high temperature. A simple enough matter of fact this, to note and apply; yet one which it is certain has been overlooked altogether ,or at best but indifferently regarded in the multi-

mode of hot cockle, hot flue, hot water, and other "hot and all hot" plans which have of late years been obtruded on the public attention.

When we first noticed this system, we instanced its application to the seasoning of beer casks, as the most striking exemplification of its efficacy which then offered itself to our observation; but though we have been fully borne out in our views of the importance of that application, by the subsequent adoption of Messrs. Davison and Symington's plans in some of the largest breweries in the kingdom, this turns out to be, after all, but one of the least of the triumphs which the system has achieved. From the seasoning of casks, the patentees have gone on step by step, till they now undertake seasoning of wood and wooden articles of every description;* and give fair promise of benefitting largely not only every art and manufacture of which wood is an element, but the public at large. We have been obligingly permitted by them to inspect and make extracts from their "Dry Seasoning Book," and some of these extracts we subjoin as affording the best possible proofs of the advantages derivable from this desiccating system. They are records of work actually done—not by way of experiment merely, but in the ordinary course of an established and fast increasing trade. Each extract shows, first, the weight of the wood when sent in to be seasoned; next the daily diminution in weight produced by the desiccating process; and, lastly, the total quantity of moisture expelled—moisture which, if allowed to remain in the wood, could tend only to produce rot and decay. The extracts give also, in the case of planks, the degree of shrinkage in width produced. Some of the results are exceedingly startling. Mahogany is reduced in weight by desiccation 24·4 per cent., and pine planks 34·5. The woods least affected are fir and white deal, which lose 12·50 per cent. The degree of shrinkage produced is still more remarkable; amounting in both the cases noticed to not less than three-fourths. It will be observed, moreover, that all these effects are produced in the course of a few days—some ten or twelve at most; while by the ordinary mode of drying they could hardly be accomplished in as many months.

We need scarcely add that the less moisture there is left in wood, the greater its strength—the more complete its fitness for every purpose to which it can be applied.

Extracts from Seasoning Book.

Fir Joists, &c.

5 Pieces (only) Weighed.	19th June.	23rd.	24th.	25th.	Measurement. 19th June.	Width. 25th.	Shrinkage.
No. 1.	16 lbs.	14½	12	12	No. 1. 5¼ × 2¼	5	¼
„ 2.	74	71	69	69	„ 2. 9⅛ × 3½	8½	⅝
„ 3.	45	41	37	37	„ 3. 8¼ × 2¼	7⅞	⅜
„ 4.	62	58	51	51	„ 4. 6¼ × 2¼	5⅞	⅜
„ 5.	118	112	110	110	„ 5. 9¼ × 2¼	8⅞	⅜
	315			279			Average shrinkage in width ⅜ full.
	279						

.36 lbs. loss, or 12.6 upwards of 12½ per cent.

Probable quantity of moisture removed from the 65 pieces 468 lbs. weight, or equal to 46 gallons water!

Average temperature of drying chamber, 120 degrees.

N.B. This wood was considered *seasoned* before it was sent to the Patent Desiccating Company's Works.

White Deal.

	July 12.											July 27.	
¾ in. White deal	91 lbs.	89½	88	87½	86	85½	85	85	84½	84¼	84	83¾	12½ per cent.
2 in. ditto.	64	63	62½	62	60½	60½	60	60	59¼	59¼	58¾	58¾	12.2 per cent

Honbeam.

	July 12.												July 29.
2½ Honbeam 5.0 long	76lbs.	71½	71	70	68½	68	67½	66½	64½	64½	640	63¾	63	62¾
													17.5 per lb.

* The works of the Company are those known by the name of the Grand Surrey Mills, adjoining the Commercial and East Country Docks, Rotherhithe; they have offices also at 28, New Broad-street, City.

Mahogany and Birch.

	July 2.												July 25.	
1⅜ in. Mahogany. 11.0 × 18⅜	81	76	74½	71½	70¼	69½	68⅜	68¼	67½	67¼	66¼	65¾	65¼	19.6 pe
1 in. Ditto. 11.0 × 22⅞	66	61	58	55	54⅜	53	52	52	52	51½	50⅜	50½	50	24.4 pe
1¼ in. Ditto.	74⅜	71	69	66	66	64½	63⅜	63	62	62	60⅜	60¼	59⅜	20 per
1⅜ in. Birch.	84	77½	73⅜	68⅜	68	68	68							

Owner's own weighing.

1⅜ in. Birch.........	95	1 in. Mahogany	73
After seasoning...	63	after seasoning	60
	32		13

Pine Plank.

		June 23.							July17.	
1⅜ Pine plank	22.0×2.2⅜	227	180	171	165	157	156	154⅜	153	152⅜	33 per ce

18 days actual work; ¾ shrinkage.

Pine Plank.

			July 31.	Aug. 2.								12th		
1 in.	Pine plank	23.0×2.0	123	109	100⅜	95	92	89⅜	86⅜	84	82⅜	82	81	34.5 Still i
1⅜ in.	Ditto.	11.0×2.2⅞	114⅜	103⅜	97⅜	94⅜	91⅜	89	86¼	82	81⅜	81	79½	32.7
2 in.	Ditto.	11.0×2.2½	138	129	124⅜	122	119	116⅜	114	110	109	108	106⅜	
2¼ in.	Ditto.	18.0×2.2⅞	244	230	219⅜	213	207½	202⅜	198½	190	186	184	180	

Spruce Deal.

		Aug. 2.					7 × 9th.		
1⅜ in.	Spruce deal.	38⅜	35	33¾	33¼	32¼	32	31¼ ×	18.8 per cent.
1¼	Ditto.	30	27	26½	26	26	25	24¾ ×	17.5 ,,
1	Ditto.	25	23	22	21½	21⅜	21	20¾ ×	17.2 ,,
⅜	Ditto.	18	14¾	14⅜	14¼	14¼	14	13¾ ×	23.8 ,,

BREAK OF BUFFERS NOT A NECESSARY CONSEQUENCE OF BREAK OF GA

Sir,—In an article in your last week's Number, you state that my plan for remedying the break of gauge is objectionable on account of the necessary break of buffers. By a reference to my plan you will find that no such objection can exist. Immediately on the narrow gauge carriages being shifted on to the broad gauge truck, their buffers would cease to act until again placed on the narrow gauge. The broad gauge trucks would be provided with buffer with the broad gauge carriages. thus proved, I hope satisfacto according to my arrangements *of buffers takes place*, I m claim the invention of the best hitherto proposed for remed break of gauge.

I am, Sir, yours,
H. H.

Hampstead, August 24, 1847.

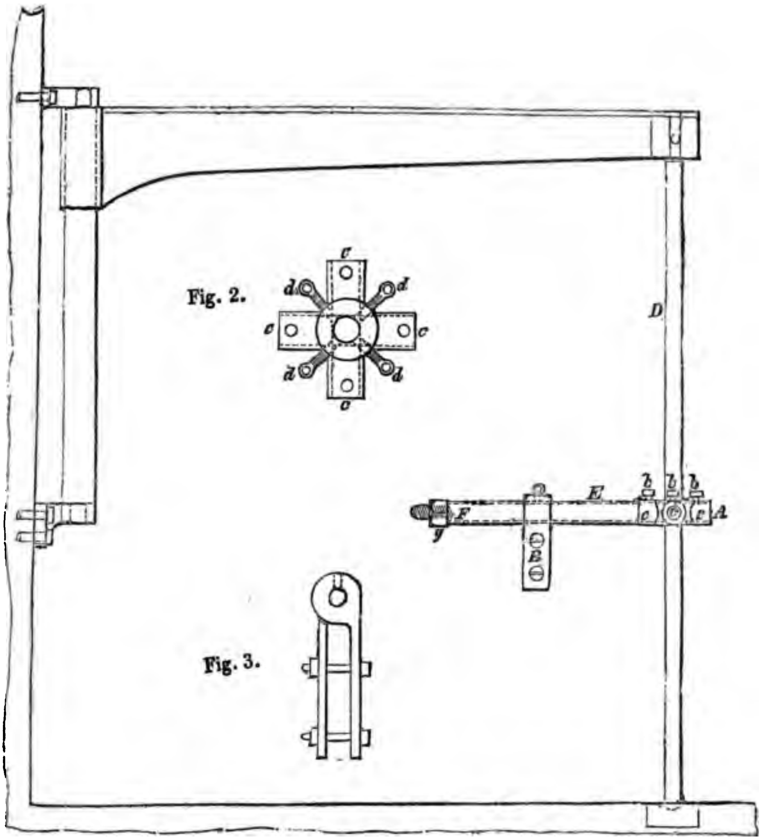
BELL'S IMPROVED LOAM MOULDERS' CRANE.

Sir,—I forward to you a sketch of an improvement in the Loam Moulders' Crane. It consists in the employment of what may be called a horizontal centre, the utility of which will easily be seen by any one who is in the least acquainted with the moulding trade. It may be applied either to cylinders with branches, or to nozles with branches, or indeed any article made with the moulders' crane. The first trial I made of this improvement was with some large nozles having double branches of 2 feet diam it answered very well. The sa arising in the making of pattern no wood being wanted, but onl board of the shape of the branch.

A crane on this plan may b work at the works of Messrs. Preston, and Co., Liverpool.

I am, Sir, yours,
GEOR

Fig. 1.



Description.

Figure 1 is a side elevation of the crane. A is a piece of round cast iron with four bosses *c c c c* cast on it, which is fixed to any length on the spindle D, by four set screws *d d d d*. A plan of this piece is given separately in fig. 2.

E is a tube which will turn on the spindle F, and is kept in its place by the nut *g*. On this tube the chops B are placed; an edge view of which is given separately in fig. 3.

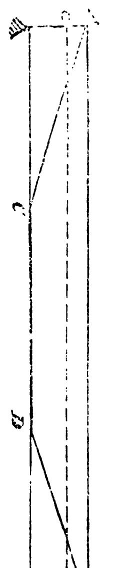
F, a spindle placed in the boss *c* and secured by the set screws *b*. If four branches are required on a pipe, &c., then four spindles and tubes similar to F should be placed in the bosses *c c c c*. There must of course be a hole in the key and centre to stop the upright centre.

CAST IRON GIRDER BRIDGES—REPLY BY MR. DREDGE TO "A. H."

Sir,—The reason I assumed $\frac{2}{3}L\mu$ to be the weight supported by each prop, E and F, was because these props are supposed to divide the girder into three equal parts; and although I am inclined to admit with "A. H." "that this need not necessarily cause any connection between them," yet in making the assumption I am not at all singular. For instance, in a suspension bridge where the weight of the chains and vertical suspending bars are$=0$, as compared with the weight of the roadway, it is demonstrable that the curve formed by the

chain would be a parabola. Now it is impossible to do this unless we not only assume that the aggregate forces in the vertical rods be equal to the weight of the platform, but also that each particular bar sustains that portion of the platform to which it is attached; and we must therefore assume a symmetrical connection between the forces resisted by each. If, therefore, I am wrong, I share the error with all writers, not only on suspension bridges but on projection generally.

"A. H." is certainly wrong in supposing that the rods AC or BD would be the first to break. For all the material that is situated above the neutral axis *a b* is compressed, and all below it is extended. Now the bars AC or BD are partly above and partly below this line, and they therefore have to resist the action both of tension and compression; and, as these forces exist in the same line, the one neutralizes the other, and it is only the excess of the tensile over the compressive force that would be acting on the bars AC or BD. It was for this reason that I did not consider the action of these bars.



If the bars were attached to separate abutments at their upper extremities instead of being connected with the beam, "A. H." would be quite right in his observations, and the tension in them would then exceed the tension in the central horizontal bar in the proportion of the *cos.* to the *cot.* of the ∠ the inclined bars make with the horizon.

I have just been desired by Lord O'Neil to design a bridge on the girder principle to cross a river flowing into Lough Neugh through his lordship's demesne. As there will be something novel in the design, I shall have great pleasure in handing it to you as soon as completed to have your opinion on it.

I am, Sir, yours, &c.,

WILLIAM DREDGE.

Castle Dawson, County Derry,
August 18, 1847.

THE WRECK OF THE "GREAT B
AND SALVAGE OF H. M. S. "GO

For several months past the p
tention has been kept alive to th
the unfortunate *Great Britain,*
graph after paragraph describing
gress of certain operations for rai
floating her, which were going on u
direction of Messrs. James and Al
Bremner, C. E. (all former plan
failed), and which it was con
predicted would result in the mo
plete success. All was said to b
for lifting her on the 13th of J
and on that day the attempt wa
but failed. On the 14th instant
attempt was made, and that
failed. We may now, therefore
cused for inquiring into the c
these failures, in order that it
seen whether the means adopt
been the most judicious that co
been used for the purpose; and
there really is any such difficult
case, as thus, apparently, to se
engineering skill of the countr
fiance.

The plan of the Messrs. Bren
described by themselves in a co
cation to the *Illustrated Londo*
of the 21st August (which contai
excellent engravings, showing t
ral stages of these operations),
follows:

*"First, twenty large boxes were
contain upwards of thirty tons
each. Ten boxes were suspended
side by strong chains, which went
lies in the upper part of large
baulks of timber, the same chain
through pullies attached to the si
ship, thus doubling the weight of
the boxes, less the friction; and, i
be added, those boxes in the middl
ship, opposite the engines, had fou
to each, to prevent straining the sh
part. Very powerful levers were p
fore-end, capable of lifting about 1
and, along the sides opposite the la
bers, formerly on the ship, were al
levers, capable of lifting about 2
each. In addition to this lifting p
boxes and levers, was applied screw
capable of lifting* 160 *tons. Thes
were placed near the hawse-holes, o
frame of timber, which was on imme
wood supports. The levers on the
of the ship were ballasted with ch
chors, and parts of the engine; as
those on the fore part. The sea ha
fore, little surface to strike against*

the levers on the land side of the ship were ballasted by a large iron boat filled with sand."

From this description it will be seen that, with the exception of the 160 tons of screw-power employed, Messrs. Bremner relied on raising the vessel by dint of mere strength or weight alone. How they calculated the weight to be raised, or resistance to be overcome, or whether they made any calculation at all, is not stated; this only appears, that, by suspending weights here, and suspending weights there, amounting in all to about 2000 tons, they expected to start the vessel from her sandy bed. Anything in the way of engineering less skilful or scientific than this, it would be difficult to imagine. However, according to the Messrs. Bremner, the mechanical force they employed—whether hit upon by chance or calculation—was actually sufficient for the purpose. We quote again their own words:

"When the lifting power was about complete, on the 13th of July (spring tide), it was thought advisable, as the good weather was passing, to make the first attempt; when, to the surprise of all on board, *the ship lifted so rapidly, that the valves had to be opened to prevent her going up farther* (! ! !) The first trial was set about too prematurely, as sufficient preparations had not been made to retain the ship at the required height; consequently, on the receding of the tide, several of the boxes and baulks were injured."

The thing was done, only it had to be undone! Trying to raise her, she rose so rapidly that they were obliged to open the valves, and let in the water to sink her again! So swift was the ascent to the surface of the water, that it was necessary to water-log her, to "prevent her going up *any farther*" (*! ! !*) (How much *farther* did they think she might have gone?) No "sufficient preparations" had been made "to retain the ship at the required height," which means, we presume, to keep her afloat; and to provide, therefore, against her sinking again, *sua sponte*, it was thought well to sink her beforehand, *à la noyade Française!*

Rendered into plain English, and real matter of fact, we take the statement which we have quoted to mean simply this: The engineers had thought only of what weight against weight would achieve, and taken no heed of what was to become of the lighter weight after it was raised; the vessel *was* started from her bed, but filled almost immediately with water, through holes in her bottom, and consequently sank again to her original position; while the weights, reeling under the great effort they had made, were some upset, and some injured, and all lowered into the mud. Another notable specimen this of engineering! The rudest of heavers could not have managed worse.

To provide against a like disaster on the second attempt, the following arrangements were made:

"Some thousands of small piles were driven, reaching from the surface of the sand to that of the rock; and on these piles were laid foundations for vertical supports, which, by an ingenious contrivance, were made self-acting, so that as the ship rose the shores placed (were intended to place?) themselves. In addition to these shores, were many immense wedges, hauled in at the fore-keel and bilges; stones were also put under her with long shutes from the deck."

The second attempt, however, (August 14,) proved so much worse than the first, that the efficiency of these arrangements was not put to the test. The vessel this time was not moved at all. The tide did not rise high enough. "No tide," says Captain Claxton, "only 6 feet 6; we want 13 fe . 6; and tide-table gave it. * * They (Messrs. Bremner) have been beat this time by the elements."

That the same weights which lifted the vessel "so rapidly" on the first occasion should not have been able to move her at all on the second, is, it must be confessed, somewhat strange—the "elements" notwithstanding; and the only way in which we can account for it (without impeaching the veracity of the account given of the first experiment, which we see no reason for doing) is, that the vessel must between the two attempts have imbedded herself in the sand more deeply than ever.

A third attempt to raise the vessel is, it seems, to be made in the course of a few days, when "very high spring tides" are anticipated.

We will not go so far as to say that there is no likelihood of success; for as long as it cannot be gainsaid that a weight of 10 lbs. will raise one of 5, there is no doubt that the thing can be done in the way Messrs. Bremner propose. But this we will unhesitatingly affirm,

that if she ever is raised, it will not be by means of any ingenuity, skill, or science, which these gentlemen have brought to bear on the task. A vulgar reliance on brute force is the broad feature of all their contrivances; they rely on it to raise the vessel, and they rely on it also to keep it up when raised. Of the aids which hydrostatics and pneumatics offer for the purpose, they are manifestly in most deplorable ignorance.

The owners of the *Great Britain* have spoken somewhat sneeringly on several occasions of the number of schemes for saving her with which they have been "pestered." We once thought them ignorantly supercilious on the matter; but if we may take it for granted, that the plan of Messrs. Bremner was the best of the lot, we must needs confess that they judged shrewdly enough. Was it really, however, the best? Or did they prefer it simply because it was more in conformity than any other with their own notions of the mechanical powers? We should not be *greatly* surprised if the latter supposition were the truer one of the two.

We know nothing of any of the schemes submitted to the Directors of the Great Western Company, and do not now speak disparagingly of the operations of Messrs. Bremner, with the view of favouring any of them. In what we have to say farther on the subject we shall confine ourselves to plans which were prepared and put in successful practice long *before* the *Great Britain* was wrecked in Dundrum Bay; and rest content with asking in conclusion, why the same plans should not have been followed in the case of the *Great Britain*, and should not now (supposing attempt the third to fail) be had recourse to?

In 1828, Mr. John Milne, of Edinburgh, published a work intituled "Plans for the Floating off of Stranded Vessels, and forRaising those that haveFoundered, with an Improved Method of carrying Vessels over Banks and Shallow Water." An account of this work was given in the *Mechanics' Magazine*, vol. xx., p. 835. Mr. Milne proposes to employ in various ways the power of vessels, or buoys, filled with air (*not sand*) to raise stranded vessels:

"While it is yet low water let a number of these buoys (or light leather bags) in a perfectly collapsed state be stowed away about the cabin of the wreck, in its hold and steerage, and let them be also down near to the bottom of the ship, by cross and upright spars against the under side of its deck; an injection pipe communicate [illegible] blowing-pump within the steam-ve[illegible] vage vessel employed for the [illegible] which may, during the operation [illegible] these buoys, be at any convenient [illegible] from the wreck. Let the blow-[illegible] begin to act, by which the buoys [illegible] be filled, and the wreck will float [illegible] the tide has risen to a sufficient he[illegible] the buoyant effect of the volum[illegible] placed within these envelopes is eq[illegible] weight of a mass of water of the sa[illegible] nitude; and since the weight of a c[illegible] of sea water is a little more than 6[illegible] avoirdupois, it does not seem to re[illegible] injection of many cubic feet of a[illegible] equal to the weight of even a lar[illegible] while in water, which, being afloat, [illegible] be towed into port by the stea[illegible] and when on its passage, if it we[illegible] that the air escaped from its envelo[illegible] might be kept perfectly full by the [illegible] continuing to discharge a sufficien[illegible] into them by the communicating [illegible] ready mentioned."

The reader will be instantly st[illegible] this remarkable feature of the [illegible] Mr. Milne, that the same powe[illegible] is employed to raise the vesse[illegible] afterwards to *keep it afloat*, and [illegible] into port; while the plan of [illegible] Bremner provides but for rais[illegible] vessel and leaving it where it wa[illegible] rated only from its hold on the s[illegible]

In 1833, Dr. John Hancock [illegible] attention to this mode of raising [illegible] in a communication to the *Me[illegible] Magazine*, vol. xx., p. 170, and [illegible] urged its general adoption.

Not many years later we h[illegible] something like it having been [illegible] adopted in several instances wit[illegible] success by Mr. Bush, the ing[illegible] enterprising, but most ill-used co[illegible] tor of the "Light for All Nations[illegible] first case was that of the *Nimbl[illegible]* which was wrecked in October, [illegible] on the Corton sands; and a[illegible] that of the *Blucher*, which s[illegible] three fathoms water off the Naze [illegible] of which vessels Mr. Bush succee[illegible] raising and carrying into port. Bush's plans differed from Mr. [illegible] chiefly in this; that he ma[illegible] of empty casks and hollow cones, [illegible] of flexible air buoys, and had, [illegible] quently, all that trouble to en[illegible] which it was Mr. Milne's object

namely, the great trouble insepa- from every attempt to attach a r of rigid hollow bodies to a ves- er water.

would not have our readers to ;, from what we have said, that ;an to represent the employ- f air-vessels for raising sunken as dating from the publication Milne's book. The fact is not npty casks had been employed, in y or another for the purpose, ut of mind; and camels (the n of the Dutch), which differ bulk and shape from casks, had n known for a century and more. ilne himself states, that he was vare of these contrivances, and only at improving upon them. e did was to suggest the employ- flexible, instead of rigid air-ves- e attachment of them, in a col- state, to the vessel, both inside and ; and the inflation of them with r they are so attached. Most e suggestions these were, and, ig to the best of our knowledge, y original.

progress of the arts since the date Milne's book, has tended greatly ice the value of his plans. Caout- was then unknown, except as a l for rubbing out lead-pencil (*unde derivatur* INDIA-RUBBER, LEADEATER, *Scott.*); and well leather was the best material lne could think of for making his bags. But now that caoutchouc ie to be applied so extensively in et state, and in a state of solution, nanufacture of air and waterproof abrics,—now that air-balls, and air- is, and air-beds made of, or with of caoutchouc, are become articles non use,—the ship salvor has at his nd a material incomparably supe- leather, and one with the aid of he may carry out Mr. Milne's vith a facility far beyond what the r himself could ever have antici- Caoutchouc bags contract and , which leathern bags do not. houc bags may be made perfectly ieable to both water and air, which n never can. And caoutchouc bags stowed away in a tenth of the which would be required for the A very small cabin would suffice as many caoutchouc bags as would e biggest ship that ever floated.

The Americans have in this, as in not a few other instances, been quicker than the English to appreciate the advantages of employing caoutchouc bags in the salvage of ships. We quote the following notice from a recent number of the *Baltimore Sun:*

"*Marine Camels.*

"We on Monday witnessed an experiment made at the U. S. receiving ship Ontario, of the power of the marine camels, the invention of Captain Taylor. The camels are simply India-rubber canvas bags, made so as to retain all the air which may be pumped into them. They may be placed under any vessel which it may be desired to raise out of the water, and in proportion to the amount of air forced into them, the ship will rise. The sloop of war under which the camels had been placed, was raised three feet in less than one hour and a half; the camels, if we may use the expression, being fed by a small air-pump, worked by but one set of hands. It was evident, from what was done, that she might have been raised, with sufficient power, we may say, almost out of the water. The design of this invention is to carry ships over bars, or to relieve vessels which may ground on a bar."

Why should not the directors of the Great Western Company (the owners of the *Great Britain*) go and do likewise? If Messrs. Bremner succeed in their third attempt—which we have admitted to be a *possible* case—there will be no occasion to call in other aid; but if they fail once more, as is likely enough, the directors will be inexcusable if they do not have recourse to the well-tested and infallible means which we have here brought under their notice.

Before laying aside our pen, it may not be out of place to add a word or two with respect to another great wreckage case which, two years ago, excited nearly as much sensation as that of the *Great Britain*. We refer to the case of H. M. steamer *Gorgon*, of 1100 tons burthen, Captain Hotham, commander, which was stranded in the Bay of Monte Video, May 10th, 1844; and after upwards of five months of incredible exertion on the part of her officers and crew, restored, nearly uninjured, to her native element. A "Narrative of the Recovery"* of this vessel has been published by Commander Astley Cooper Key, one of the lieutenants of the *Gor-*

* 8vo., 112 pp., with numerous plates. Smith and Elder. 1847.

gon at the time of the disaster, which, though written more particularly for the information of members of the author's own profession, is deserving an attentive perusal by all who are, or may be, in any way concerned with the salvage of vessels. The fertility of invention evinced by Captain Hotham on the occasion, the ingenuity and frequent originality of his plans, the sagacity with which difficulties were foreseen and provided against, the judgment with which orders were given and cheerfulness with which obeyed, and the unflinching energy and perseverance displayed by all concerned, from first to last, have found in Commander Key a faithful and most agreeable chronicler. Although we cannot cite the *Gorgon* as an instance of a vessel saved by the sort of agency we have been recommending (for she was saved chiefly by shore purchases and screws), yet we can cite both her commander and the writer of the "Narrative," as bearing unqualified testimony to the superiority of that agency over all others. Captain Hotham did, in fact, have recourse to the use of camels, and derived great assistance from them; but, owing to an accident, described in the following interesting extracts, they were put *hors de combat* before the ultimate rescue of the vessel by other means:

"This day's experience (22nd August) was bitter; it showed clearly that the general means adopted were inadequate to the accomplishment of the undertaking. The camels were our only resource * * * The advantage of the camel in reducing the draught of water, especially in a case like the present, is so obvious, that the inquiry would naturally suggest itself, why were they not earlier thought of, and brought into use? This is easily answered; in the first place, economy required that the means which were considered adequate, should be *proved* not to be so, before others were resorted to; and secondly, the excavations in the dock were only *now* sufficiently advanced to admit them."

* * * *

"On the 16th of September, a mid-day, a sudden squall from the ward caused the water to rush into with such force as to raise it three f few minutes, bringing it therefore or with the top of the camels. Wl camels were totally immersed, an exerting their whole power, *they l immediate effect of bringing the s right.*"

* * *

"We had been assured that afte ber, all hope of any extraordinary tide was at an end; from the commen of that month, therefore, every indic a southerly gale was watched with in anxiety; we considered ourselves i way prepared, our only daily empl consisted in the continued excavatio dock and channel, which would admi cessation. At any ordinary rise of w the ten-feet mark, for instance, the s evidently quite alive abaft, the slighte setting into the bay was sufficient t *the immense power of the camels to mediately perceived*, by the motic communicated to the ship; if either on one side sprung a leak, which o once or twice, the ship instantly lift two or three degrees to that side, an righted when the camel was repai pumped out dry."

* * *

"Before relating the account of o happy release, let us pause, to remi reader what power was at the present applied, after all the changes and alt that had taken place, and which ha so confusedly recounted in the pr pages. And, first, as to the lifting or that applied to lessen the ship's of water: The *amount* of this is ea certained; but the actual *effect*, th say, the exact reduction, is not so si the attainment: the investigation involve more delicate and abstruse tion than is consistent with the char this publication. The form of the bottom, her exact displacement, an data, would also be necessary, bef result, in the slightest degree approx the truth, could be obtained. Let u fore be content with the mere am power, which may be tabulated thus

Port side.	Tons.	Starboard side	Tons.	Astern.	T
Camel (1)	56	Camel (2)	64	Caisson	
„ (3)	63	„ (4)	49		
„ (5)	76	„ (6)	66		
Boilers	10	Tanks............	14		
16 Pipes..........	8	10 Pipes..........	5		
	213		198		

Summary.

	Tons.
Port side	213
Starboard side	198
Astern	57
Total............	468

a total of 468 tons directly applied the ship's draught; and, from the ɪn of power, every ton is clearly and ' available. There is no loss from ɔr bad material: no doubt as to r force being exerted, as is the case ɑal power; the machines are in s helpless; they are forced to put r whole strength; and, as long as ɪntirely immersed, there can be no or diminution to their exertions."

* * *

ɪhip had been dragged her whole en No. (1) camel slipped from its ɗ rising, the surf struck it heavily ɪe ship's side, by which it was ɔn the whole of the camels followed ample; this was grievous indeed, ɪip was now entering the mud, and to move, though more heavily re."

* * *

ɪeason of the defection of the ca- very evident. The gripes, by y were boused close to the ship's made fast below the camels to the ɔo this, at the stern post, was also ɪe standing parts of the runners on ɪg-off cables; therefore, when these ɪay, and were unrove, the swifter, , slacked: this gave the camels a ɪ, which was increased rapidly by and finally, so as to trip up the ɪhey were then completely adrift."

* * *

ɪhip was still imbedded four feet in which was now considerably softer t nearer to the sand. But as we assured that she could be dragged main strength, and at little more ɪrdinary tide, the intention of re- the camels and 'caisson' was, of bandoned."

ngines of the *Gorgon* were em- ɪs the principal moving power ing the purchases and screws, author of the "Narrative" ɪr Captain Hotham the merit of ɪeen the first to turn to so useful nt what had previously been re- s one of the greatest obstacles to the salvage of a vessel under such circumstances:

"I believe it may be with propriety assumed that a very general impression has prevailed in the navy, that one of the great difficulties attendant on officers commanding steamers would be, getting them afloat, should any disaster throw them on shore. The necessity of removing the engines was always admitted; and the minds of naval men had been turned to simplify a process considered as a *sine quâ non*. It was reserved for the *Gorgon*, a vessel with engines of 300 tons weight, to prove to the world that an officer should consider well his position, before he adopted too hastily a plan that would inevitably render his vessel at once unserviceable. As a matter of course, the advantage to be gained by their removal struck every one; but this was more than counterbalanced by the difficulties attending the operation, the expense to be incurred, and the probable loss or injury of many small parts, and more than all, by the declaration of the engineers that the resources at their command were *not* sufficient for their restoration and re-erection. Weighing well the advantages and disadvantages held out by either course, it was wisely determined to retain them, and employ them as the principal moving power; but, as is, and ever will be the case, when any new idea is started, public opinion declared against it, the folly and madness of the plan was in the mouths of every body; still Captain Hotham remained firm, in defiance of the entreaties of his friends, and the ill-repressed hints of other self-constituted critics. His determination was that the engines should remain on board, and be used as the principal power for transporting the ship."

We have quoted the preceding passage with a special view to its bearing on the case of the *Great Britain*. Should recourse be had to the use of air bags, a considerable power will be required to inflate them; and Captain Hotham's example shows that none better can be employed than that which the vessel's own engines afford.

CALENDAR OF SPECIFICATIONS OF PATENTS OF INVENTIONS. FROM THE PERIOD WHEN THE PRACTICE OF ENROLMENT COMMENCED TO THE PRESENT TIME.—CONTINUED FROM P. 166.

[From the Reports of the Deputy-Keeper of the Public Records (Sir Francis Palgrave).]

THE CALENDAR.

[Of the two dates annexed to each entry, the first is the date of the patent, and the second that of the enrolment of the specification.]

Moses Bird, of Walsall, Stafford, locksmith: of a guarded lock, bolt, or box, to be applied to the bolt for the better securing of locks, latches, bars, and turnbuckles, which will be of great use in securing sashes in the frames, doors, drawers, desks, and bureaus from being opened by any picklock or false instrument. Cl. R., 30 Geo. 3, p. 17, No. 1. October 29, now last past; Nov. 27, 1790.

William Whitmore, of Birmingham, tool maker: of a method of making shanks or eyes for buttons by the application of rollers, presses, and other implements. Cl. R., 30 Geo. 3, p. 18, No. 2. Nov. 16, 21 Geo. 3; Dec. 11, 31 Geo. 3, 1790.

William Redman, of New Sarum, Wilts, tin plate worker: of a new-invented iron back, adapted to all sorts of stoves and grates used in fire-places in rooms, which, by rarifying the air, will accelerate and impel the ascension of the smoke, cause the fire in the grate to burn free and clear, prevent any smoke in the room, and give a much greater heat than stoves or grates without such backs will do. Cl. R., 30 Geo. 3, 23, No. 20. July 28, 30 Geo. 2, August 24, 1790.

James Frost, of Norwich, carpenter: of new-invented and improved methods of constructing, fixing, and arranging window lights and sashes of all descriptions whatsoever: [consisting: 1ly. In forming window sashes of metal, cast either whole or in parts as may be found necessary, and with mitre joints complete, both in the mouldings and rabbets intending to hold the glass; 2ly. In forming molds for casting these new-invented window sashes of brass or of iron, or of other metals, either by themselves or compounded, or of sand, clay, or other composition.] Cl. R., 30 Geo. 3, p. 28, No. 1. April 27, 30 Geo. 3; May 27, 30 Geo. 3, 1790.

Adam Heslop, of Ketley, Salop, engineer: of an invention of an engine for lessening the consumption of steam and fuel in fire or steam engines, and gaining considerable effect in time and force. Cl. R., 30 Geo. 3, p. 31, No. 1. July 17, 30 Geo. 3; Aug. 16, 1790.

John Syeds, of Southwark, ma[i]
new machine or instrument, call
proved quadrant, for determining t[h]
at sea when no horizon can be [f]
for the easier ascertaining the
Cl. R., 31 Geo. 3, p. 1, No. 5.
31 Geo. 3; Feb. 14, 31 Geo. 3, 1

William Dufour, of Marylebo[n]
of an invention of a machine, calle
balcony, or private family fire e[s]
the preservation of lives and pro[p]
the dreadful effects of fire. Cl. R
3, p. 1, No. 4. Jan. 24, 31 Ge[o]
18, 1791.

Isaac Manwaring, of Clerken[well]
maker: of a new invention for
pendulum steam engine, with tw[o]
cylinders, to work immediately up
or wheels without a crank, long
lever, as now used, and in a manne
from the hitherto accustomed mod
ing steam engines, which may be
the whole or by the several pa[rts]
applied to any works where great
force is required, and equally ap[p]
the raising of water, &c., &c.
Geo. 3, p. 2, No. 19. Feb. 10, 3
March 10, 1791.

William Shorland, of Bristol,
and engineer: of a new-invented
chine, or machinery, calculated t
mills and all kinds of works, drov[e]
from being flooded or impeded b
tail water, through the operation
of double power, overshot-wheels,
gates, and for grinding, &c. of ev
of grain, foreign or domestic pr
the powdering and whitening of
of sugar; such mill, machine, or
to be worked either by water, win
labour, steam, horses, or any ot
Cl. R., 31 Geo. 3, p. 2, No. 16.
31 Geo. 3; March 21, 1791.

John Bevans, of Clerkenwell, j
new method of making circular w
frames, sashes, and soffits, fanlig
mouldings, and hand-rails for st
bending them in one entire pi
wood be of sufficient length, wi[t]
of hot water, steam, and certain m
Cl. R., 31 Geo. 3, p. 2, No. 7
instant; April 21, 31 Geo. 3, 17[9]

Colin Mackenzie, of Oxford Mar
le-bone: whitesmith: of a new-in[v]
for a chain, and a certain way a[n]
of making a chain of such links
the same, and which may be used
ing chain, ship cabie, watch ch[a]
any other purpose where a ch[a]
used, and which can be lengthene[d]
ened at pleasure by adding or ta
such links without cutting or bre

more of them. Cl. R., 31 Geo. 3, o. 2. August 13, 31 Geo. 3; Sept. 1.

am Jayne, of Sheffield, confectioner: ention of a composition or mixture ing and preserving perfectly sound pace of two years at the least the hens, turkeys, geese, and ducks. 31 Geo. 3, p. 13, No. 1. Feb. 8, 3; Feb. 22, 1791.

as Mead, of Sculcoates, (York,) : of an invention of "a recipro- re or steam engine or machine, upon new principle, for the use of mills, cranes, carriages, and other pur- here the force of fire or steam is ." What particularly relates to the is the heating and rarefying the uid after it has left the boiler, and ls causing it to pass through the luid in the same, by which means ne is kept in motion with a less con- of fuel than by other methods now nd at a considerable less expense. 31 Geo. 3, p. 20, No, 3. August eo. 3; September 3, 1791.

Summers, of Laurence-hill, Glou- heelwright: of an invention of con- ; a steam engine, by which may be nills for grinding, rolling, cutting, or any other sort of machine that can ght by water with the greatest degree rmity, by a new-invented figure, e Sub Supra, and others connected h, by which means such engine will perior power above any of the com- struction. [To this engine may be the new-invented machine, called lraufical Index or Steam Regulation, eeps the motion of the engine as as possible.] Cl. R., 31 Geo. 3, o. 14. October 6, 31 Geo. 3; No.

(*To be continued.*)

NOTES AND NOTICES.

Mountain.—De Smet, an English mis- a writing to the *Freeman's Journal* from ys:—"Not far from the place of our en- t we found a new object of surprise and n. An immense mountain of pure ice, high, enclosed between two enormous o great is the transparency of this beau- hat we can easily distinguish objects in it pth of more than 6 feet. One would say earance, that in some sudden and extra- well of the river, immense icebergs had ed between these rocks, and had piled s on one another, so as to form this mag- lacier. From the base of this gigantic ne river Trou takes its rise,"

agement to the Blue Dahlia Seekers.—A phenomenon, says a French paper, has elf in a greenhouse at Lyons. At the a all the growers of camelias, roses, dah- are puzzling themselves to get the blue e only shade which nature has refused to ls of plants, chance has thrown a shade of azure blue upon the petals of flowers produced by one single branch of a camelia root of the species *imbricala rubra.* This plant belongs to M. Dagene. The interior petals of the flowers are of a delicate red, the superior are white, and both are united with blue. The flower thus unites three additional colours.

No Proof of the Present Existence of a Single Star or Planet—Sir John Herschel, in an "Essay on the Power of the Telescope to penetrate into Space,"—a quality distinct from the magnifying power, informs us that there are stars so infinitely remote as to be situated at the distance of *twelve millions of millions of millions of miles* from our earth; so that light, which travels with a velocity of twelve millions of miles in a minute, would require *two millions of years* for its transit from those distant orbs to our own; while the astronomer who should record the aspect or mutations of such a star, would be relating, not its history at the present day, *but that which took place two millions of years gone by!*

A Cheap Signal Light.—The *Revue du Havre* states that a young chemist of that town has invented a system of lights for ports and coasts, consisting of a thick globe of glass, in which is enclosed a preparation giving a light like that of the moon, the cost of which for one year will not exceed a franc.

Tortoise-shell Bonnets.—In the British Museum there is a tortoise-shell bonnet shown, which came from Navigator's Island, and was presented to the institution by her present Majesty.

A Dear Table.—Cicero is said to have first brought into fashion at Rome tables of tiger and panther wood. He gave for one a million of sesterces, (£8072.)

Berlin Castings.—Ehrenberg states that the peculiar fineness of these castings is owing to the iron and sand employed being of a peculiar quality, and only to be met with in the neighbourhood of Berlin. The former is made from bog-ore, and the latter is a sort of tripoli, containing a considerable admixture of iron.

The Partridge and Penang Canes, so much in vogue, are made from the cocoa-nut palm of South America—one of that endogenous tribe of plants which have only one set of fibres, and those vertical, which exhibit in their transverse section the irregular dots so much admired.

Improvements in Gun-cotton.—Mr. Coathupe recently forwarded to the Chemical Society two specimens of gun-cotton, with a view to illustrate the greatly increased explosive effects that are to be derived from a subsequent immersion of the gun-cotton, when properly prepared in the ordinary way, in a saturated solution of chlorate of potash. "Having experimented with solutions of nitrate of ammonia, nitrate of potash, nitrate of soda, bichromate of potash, &c., for the purpose of increasing the explosive properties of this interesting substance, I can affirm that none of the results will bear the slightest comparison with those obtained from the solution of chlorate of potash, either in rapidity of ignition or in intensity of flame. The process adopted for preparing the enclosed specimens was as follows—viz.: into a mixture of equal measures of strong nitrous acid, and of oil of vitriol, spec. grav. 1·845, the cotton was immersed and stirred with a glass rod during about three minutes, it was then well washed in many waters, and dried; a portion of it was then soaked for a few minutes in a saturated solution of chlorate of potash, well squeezed and dried."

Navigating against the Wind.—Gardner, in his travels in Brazil, relates an expedient by which his Indian guides succeeded in navigating against a violent wind down one of the rivers of that country. They went ashore, and cutting off a considerable quantity of branches from the trees, which there grew in abundance, they tied them tightly around the middle with a cord, one end of which they attached to the canoe. Then steering for that part of the stream where the current was the strongest,

they threw the bundle overboard, which, from its green state, sank just below the surface of the water, and being thus secure from the influence of the winds, the canoe was carried rapidly down the stream.

The Power of the Press.—In the year 1272, the wages of a labouring man were just three half pence per day; and at the same period, the price of a Bible well written out was £30 sterling. Of course, a common labourer in those days could not have procured a Bible with less than the entire earnings of thirteen years! Now, a beautifully printed copy of the same book can be purchased with the earnings of half a day!

A Tunnel under the St. Lawrence—It is proposed to tunnel the St. Lawrence, opposite the island of Montreal, in order to connect the railroad running to the Atlantic. The proposed tunnel under the St. Lawrence at its narrowest part, near St. Helen's Island, will be about one-third of a mile from shore to shore, and about one-third the length of the principal tunnels in England. The depth of the water in the river is 43 feet.

A Novel Salute.—When General Washington, while president, visited the works of the James River canal, the chief engineer caused the quarriers to charge some hundreds of blasts, which were exploded at Washington's approach. This internal navigation salute he pronounced the most gratifying he had ever heard.

The Atmospheric Railway System.—The South Devon line, from this city to Teignmouth, has this day been worked throughout with the most complete success. The distance from this city to Teignmouth, including stoppages at Starcross and Dawlish, was performed in 42 minutes, with the utmost ease and precision. It is expected that all the transit will be made by the atmospheric in the course of a day or two! So much for the croakers!—*Besley's Exeter News.*

DREADFUL STEAM-BOAT EXPLOSION.

The *Cricket*, one of the A. B. C. steam-boats which ply on the river at halfpenny fares, has been blown up this morning (Friday), while taking in passengers at Hungerford Bridge Pier. A great many people have lost their lives, and many more have been wounded. The engines were on the high-pressure principle, and will be found described in this journal for 11th July, 1846 (No. 1196).

LIST OF ENGLISH PATENTS GRANTED FROM AUGUST 19 TO AUGUST 23, 1847.

Edward William Eaton, of New Windsor, Berks, bachelor of medicine, for certain improved machinery for preventing accidents by railway. August 19: six months.

Osborne Reynold, of Dedham, Essex, clerk, for improvements in making hop-poles, hurdles, fencing-ropes, basket or wicker work, and other similar articles. August 19; six months.

William Bacon, of Bury, Lancashire, engineer, and Thomas Dixon, of the same place, engineer, for certain improvements in steam-engines. August 19; six months.

William Eaton, of Camberwell, Surrey, engineer, for certain improvements in raising water and other liquids from one level to another. August 19; six months.

Orlando Brothers, of Blackburn, Lancashire, engineer, for certain improvements in the method of manufacturing retorts, and in the machinery or apparatus connected therewith. August 19; six months.

Archibald Farries, of Preston, Lancasl tleman, for improvements in propelling on common roads. August 19; six mont

Francois Augustus Renard, of 40, Rue d Paris, for improvements in preserving an ing wood. August 19: six months.

James Webster, of Sneinton, Nottingh neer, for an atmospheric buffer to be a carriages and other vehicles travelling on August 19; six months.

Aime Bowra, of Rathbone-place, Middle and scourer, for improvements in colou ters. August 19; six months.

Alexander Speid Livingstone, of No. ; place, Lewisham, Kent, civil engineer, f improvements in the construction of l engines intended to be used on railways. 23; six months.

Thomas Dansom Pruday, of the Fr Tavern, Great Queen-street, Middlesex, certain improvements in apparatus for vegetable and other substances to small August 23; six months.

MONTHLY LIST OF PATENTS GRAN SCOTLAND FROM THE 27TH OF THE 20TH OF AUGUST, 1847.

John Yule, of Sauchiehall-street, Glas tain, for certain improvements in chair railways, and in fixing the same. July 2

Henry Mapple, William Brown, and Jan Mapple, of Child's Hill, Hendon, for impr in communicating intelligence by means city, and in apparatus relating thereto which improvements are also applicable purposes. August 2.

Moses Poole, of London, gentleman, for ments in the manufacture of cast metal, steel. (Being a communication from abro gust 5.

Robert Stirling Newall, of Gateshead, certain improvements in locomotive engi gust 6.

John Macintosh, of Bedford-square, M gentleman, for improvements in engin worked by steam or other suitable fluid provements in propelling carriages and August 6.

William Thomas, of 129, Cheapside, merchant, for certain improvements in sta improvements are applicable to other u poses. (Being a communication from abr gust 11.

Pierre Armande Le Comte de Fontainer 4, South-street, Finsbury, London, for ce provements in the machinery for cutting in laying and uniting veneers. (Being a cation from abroad.) August 11.

James Webster, of Sneinton, Nottingha improved atmospheric buffer to be applie way carriages and other vehicles travellir ways. August 12.

John Thompson Carter, of Droghed county of the town of Drogheda, in Ire spinner, for improvements in machinery ing, bruising, and preparing flax, hemp, fibrous materials requiring such treatm gust 16.

Frederick Steiner, of Hyndburn cott Accrington, Lancaster, Turkey red dyer provements in the manufacture of sugar a communication from abroad.) August

Thomas Birchall, of Ribbleton-hall, I gentleman, for improvements in folding n and other papers. August 16.

James Morison, of Paisley, of Renfr manufacturer, for improvements in applyi in propelling or moving carriages, and motion to machinery. August 18.

Philip Henry Holland, of Charlton-u lock, Manchester, Lancaster, surgeon, fo ments in applying manure to land. (Bei munication from abroad.) August 20.

LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED UNDER 6 AND 7 VIC. CAP. 65.

Date of Registration.	No. in the Register.	Proprietors' Names.	Address.	Subject of Design.
Aug. 19	1169	Turner and Pegg	Leicester	Rectangular woven elastic bands.
„	1170	Edward Gadsby	Noble-street, Cheapside............	Improved buckle for braces, and other purposes.
20	1171	James Comins.........	King-street, South Molton, Devon, whitesmith............	Improved one-way turn-over, or turn-rest plough; also a hoeing, earthing-up, or potato plough.
21	1172	Henry Summersgill..	24, Nile-street, Church-street, Preston, Lancaster, watchmaker..............................	An improved going barrel, or main-spring box, for watches.
„	1173	Brown, Marshall, & Co.........................	Birmingham........................	Improved spring roller for glass frames, to be applied to railway and other carriages.
„	1174	William Wharton ...	London and North Western Railway Station, Euston-square..............................	A continuous band.
23	1175	Charles Dowse...........	Camden Town	Memorandum book.
24	1176	John Duffell...............	Birmingham..........................	Steel mill.
„	1177	Lawson and Holden.....	Birmingham..........................	Railway roof-lamp.
26	1178	François Teychenne, James Waterman, and Phillip Powell	Cripplegate, London, feather merchants	Pillow, or cushion.

CONTENTS OF THIS NUMBER.

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Edited by J. C. Robertson, 166 Fleet-street.

MR. BRAITHWAITE'S PATENT IMPROVEMENTS IN HEATING, LIGHTING, AND VENTILATING.

Fig. 1.

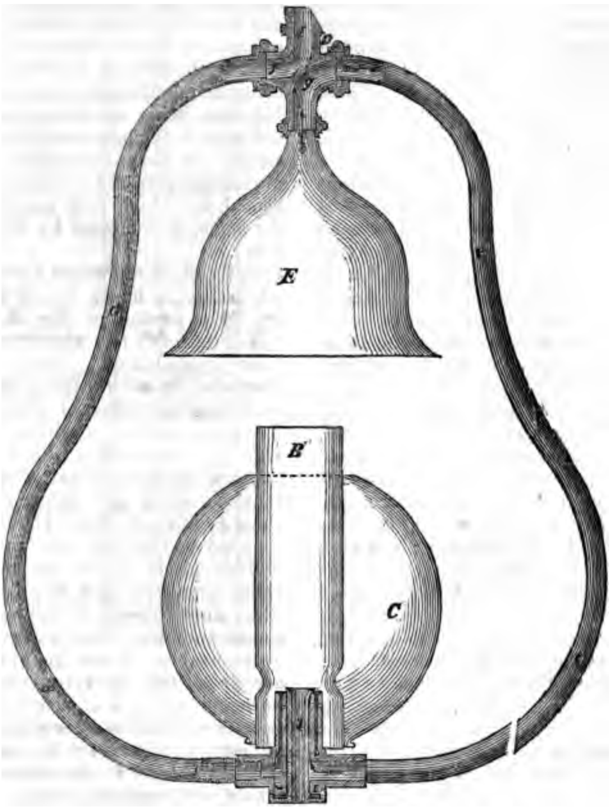
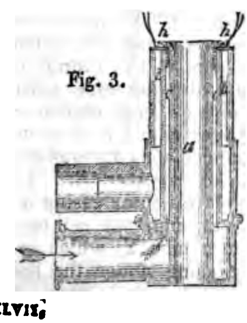


Fig. 3.



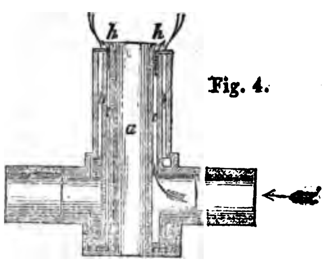


Fig. 4.

MR. BRAITHWAITE'S IMPROVEMENTS IN HEATING, LIGHTING, AND VENTILATING.

[Patent dated 28th January, 1847. Patentee, John Braithwaite, Esq., C. E.]

The invention which forms the subject of this patent consists in certain improved arrangements of mechanical and pneumatic means, either new in themselves or employed in a new state of combination, which have for their object, *firstly*, to render gas and other lamps self-preventive of noxious exhalations, or, in other words, to cause them to consume their own smoke and noxious exhalations: and, *secondly*, to effect the better heating and ventilating of buildings, apartments, and other confined places.

Fig. 1 of the accompanying engravings exemplifies the manner in which the first branch of the invention is to be carried into effect, by showing how it may be applied to, or embodied in, a gas lamp of one burner, suspended from the ceiling of a building or apartment. And fig. 2 is an exemplification of the manner in which both the first and second parts of the invention may be carried unitedly into effect, by showing their application to a pendent lamp of two, three, or any greater number of burners.

Each of these figs. (1 and 2) is a sectional elevation of the particular apparatus which it represents. A, fig. 1, is the burner; B, the chimney; and C, a globular shade. The burner A is separately represented, of its full size, in the two sectional views, figs. 3 and 4. It consists of three concentric tubes, *a*, *b*, *c*, which are respectively appropriated to the passage of the air, gas, and smoke. The innermost, or air tube *a*, terminates at bottom in a flange or ring, which is screwed or otherwise fastened to the two other tubes *b* and *c* (which are cast in one piece), as shown, and at top it is made of a bell-mouthed or other suitable form, so as to overlay to a considerable extent the top of the next adjacent or smoke tube *c*. The burner, with its chimney and shade, is kept suspended by means of two tubes, *d* and *e*, the under ends of which are connected to the burner, and the upper ends to a two-way piece D attached to the gas supply-pipe. The tube *d* serves for the supply of gas, communicating through the passage *f* of the two-way piece D with the gas main, and opening at bottom into the outermost tube of the burner, whence it flows to the apertures of ignition. E is a receiver or collector, which is suspended from the two-way piece D immediately over the chimney B, and communicates by a hollow shaft with one end of the passage *g* of the piece D. The tube *e* is attached to the other or opposite end of the passage *g*, and serves to lead the smoke and noxious exhalations which collect in the glass E back to the burner, in order to be there consumed. The smoke and noxious exhalations being conducted into the central tube or compartment *c* of the burner, ascend till they encounter at top the overlaying part of the tube *a*, being deflected, by which they impinge against the flame, as indicated by the arrows at *h h*.

In fig. 2, M represents a portion of the side wall of a house or other building, and N a portion of the flooring and ceiling between two apartments of such house or building. L is a gas lamp suspended from the ceiling of the under apartment by means of a tubular pillar *l*, from the bottom of which two tubular arms l^1 l^1 branch off at right angles, each terminating in a burner A of the same construction as that before described, with chimney B, and shade C. The gas is supplied to the burners through the tubular pieces l l^1 l^1, the main piece being connected at top to a feed-pipe P, which runs between the ceiling and floor, and communicates with a gas main in the usual manner. From the burners A A, and from the compartments of these burners (which compartments are not seen, however, in the figure now in course of description), two smoke pipes (*e e*) are carried upwards in the curved direction shown, and hold suspended from their beaks (immediately over the burners) two receivers E E, exactly similar to those employed in figs. 1 and 2, and before described. W W is an outer casing which encloses, but without touching, the greater part of the central tubular pillar *l*, and also the upper portions of the smoke pipe *e e*, each branch terminating at its lower end *a a* in a mouth-piece which immediately surrounds the neck of the smoke receiver E. The central branch of this outer casing is prolonged upwards through the ceiling, and there joined to a tube Y, which passes horizontally along under the floor of the

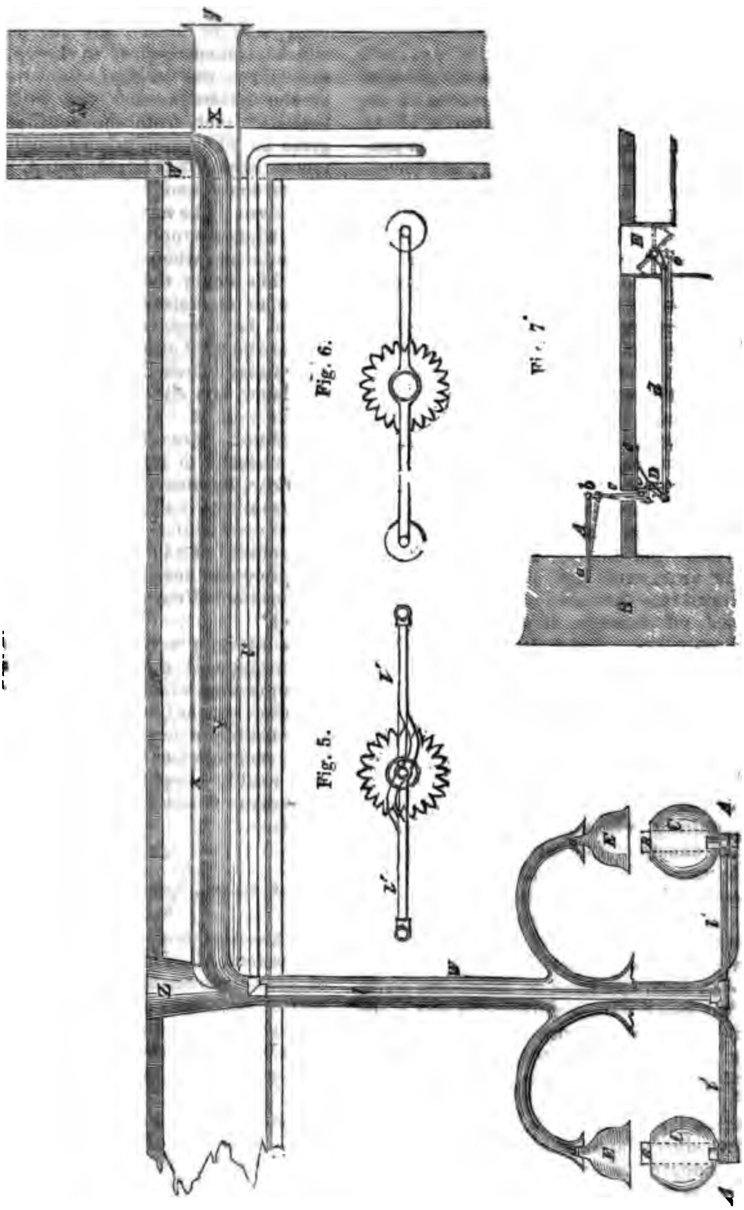


Fig. 5.

Fig. 6.

Fig. 7.

upper apartment and enters a vertical flue $W^1 W^1$, in the side wall of which it is carried to the top of the building, or any other convenient point of exit into the atmosphere. X X is an air passage, which is carried from the outside of the building at *y*, beneath the flooring of the upper apartment; it encloses in its progress the horizontal pipe Y, and terminates in an aperture *z*, which opens into the upper apartment. Figures 5 and 6 are plans of the outer casing W, and gas tubes *l* as seen from above. The gas, smoke, and other tubes are made of copper, iron, or tin, as usual.

The operation of the apparatus, which has been just described, in so far as regards the consumption of the smoke and other noxious exhalations arising from the burner, is precisely similar to that of the apparatus represented in fig. 1, but it is attended with this further advantage, that the greater part of the heat, which radiates from the gas and smoke tubes, and also all the lighter and more vitiated portions of the atmosphere of the apartment, are intercepted by or drawn into the outer casing W, and carried off through it into the external atmosphere, while in their progress through the horizontal pipe Y, they impart a degree of heat to the supply of fresh air flowing in through the surrounding pipe X X.

Where the apartment, or place to be lighted, has no connection with any other apartments or place, above or below it, requiring to be warmed or ventilated, as for example, the interior of a railway carriage, the cold air-pipe would of course be dispensed with.

The aperture *z*, which opens into the upper apartment in fig. 2, may be covered with a fixed perforated plate, as is usual with such apertures in floors and walls. Mr. Braithwaite regulates the flow of air by means of a throttle-valve or damper, acted upon by what he terms a "thermostatic lever," through the medium of or by wooden connecting-rods. The thermostatic lever is made as follows: "I take two slips of any metals possessing different degrees of expansibility, such, for instance, as iron and zinc, of about 15 ins. in length, 1 inch wide, and three-sixteenths of an inch thick, more or less, and connect them by soldering or riveting them together face to face. I make this compound lever fast by inserting one end in the wall or brickwork building, and attach it by the ot bell-crank or lever, and thenc wooden connecting-rod to the spi the valve: the greater the h greater will be the curvature in tl mostatic lever, from the conflict grees of expansibility possessed metals of which it is composed, greater consequently the rise or op the valve. The valve is thus alwa open when a supply of fresh air wanted; and when the general te ture falls so low that no further i fresh air is desirable, it become should be, closed altogether. I I have shown the connection betw thermostatic lever and the valve the lever, one end of which (*a*) in the wall B. C is the floor apartment. The other end *b* of tl is connected to a bell-crank D l the floor, by means of a wooden and from the bell-crank D by wooden rod *d* to the lever *e*, atta the spindle of the valve E. Th is represented open; the dotted lin the position of the respective par closed."

In all the preceding exempli gas is supposed to be used, but tl arrangements will be equally ap whether gas, oil, tallow, or an combustible material is emplo with such obvious modifications will readily suggest themselves workman of ordinary skill and gence.

REPLY TO MR. DREDGE ON IRON BRIDGES.

Sir,—As I find that I have n understood Mr. Dredge's *meanin* of your mathematical readers wi seen at once that Mr. Dredge's of the problem he has undert quite wrong—(even granting h own assumption, viz., that the

borne by each of the two props is

inasmuch as he has unaccountabl ted all consideration of the pr sustained by the abutments. Th weight being $2\,L\mu$, if we even all the portion borne by the two p $\frac{2}{3}L\mu$, there remains $\frac{4}{3}L\mu$ to b

two abutments, so that, if we ute for P and Q in the value given ast paper for M, the values $\frac{2}{3}$ Lμ ıd $\frac{1}{3}$Lμ for Q, it becomes

$$=L\left(\frac{2}{3}L\mu+\frac{1}{9}L\mu-\frac{L}{2}\right)$$

$$=L^2\mu\times\frac{5}{18}.$$

w it in whatever way we may, dge's reasoning will be found to isistent even with itself; for, assumption that all the supports al portions of the weight, then ing four of these supports, viz., props and the two abutments, these will bear $\frac{2\,L\mu}{4}$ or $\frac{L\mu}{2}$ in- $\frac{L\mu}{3}$ as Mr. Dredge has got for the *props*. Indeed, he has tently I suppose) contradicted -for in his original investiga- ays the pressure on each prop is

page 105, col. 1,) and in his

says " the reason I assumed

be the weight supported by each

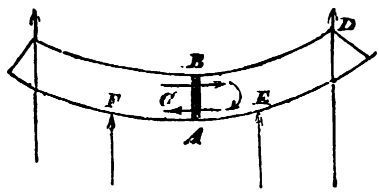
ius making it double of what he ierly assumed.

. hardly say however to any ma- al reader, that such reasoning ied by Mr. Dredge—even though consistent with itself—is alto- nsafe and unrecognised by any reat writers on mechanics.

Mr. Dredge's not making the allusion, either in his original r in his reply, to the re-actions utments, I am at a loss to under- iat he supposes the abutments do, or whether they have any- all to do with supporting the because if they have, Mr. ias never taken the slightest ac- them (*i. e.* in taking the moment rces). In order that there may ie slightest doubt left as to the made in determining the value ioment round the neutral axis— arising from entirely neglect- of the acting forces (*as well as* incorrect assumptions as to the rest), I will here give the mode in which this moment is obtained.

Let AB (fig. 1) be the section of fracture, C being a point in the neutral axis: each of the pressures at the abutments $=$P and each of the pressures sustained by the props $=$Q.

Fig. 1.



The fibres above C being in a state of compression, and consequently endeavouring to expand to their natural state, their action may be represented by a single force (since their directions may be considered nearly parallel when the deflection is small) whose direction is that of the upper arrow. Similarly the action of the extended fibres below C may be represented by a single force in the opposite direction as in the lower arrow. The combined effect of these two forces is to turn the right hand half of the beam, from B towards A round C, as represented by the curved arrow. Of course their effect on the other half of the beam to the left of C is just the opposite. The right hand half of the beam therefore is kept in equilibrium by the following forces: P at D and Q at E which are vertical, its own weight which $=$Lμ and the elastic forces at C, whose moment round C we have called M. Consequently this moment must be exactly equal and contrary to that of the forces P and Q, whose distances from C are BD$=$L and AE$=\frac{1}{3}$L. and of the weight of the half beam acting at its middle. Hence is obtained the equation given in my former paper,

$$M=L\left(P+\frac{Q}{3}-\frac{L\mu}{2}\right).$$

To the question, then, why in forming his equation for the moment of the forces, he neglected to take any account of P, Mr. Dredge has returned no answer. If there were another force or pressure$=$R suppose acting at a distance (p) from

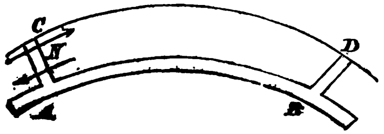
C vertically upwards, then the above value for M would become

$$M = L\left(P + \frac{Q}{3} + R\frac{p}{L} - \frac{L\mu}{2}\right).$$

And so on for any number of forces. I must apologize for occupying so much of your space on so very elementary and simple a process, but without doing so I could not point out where Mr. Dredge has erred.

With regard to the next question, perhaps the following mode of viewing it may assist the conception:

Fig. 2.



Suppose we take a bar, A B, Figure 2, connected by A C and B D, with another piece C D, and bend it with the hands into the position of the figure, is it not evident that A C and B D may be so thin and slight as to be incapable of transmitting the action to C D—in which case they will be the first parts to break. If so, it becomes simply a question—*how* strong ought these pieces to be made? Suppose N to be the neutral point in A C, the forces below N are tending to turn it one way and those above it the exactly contrary way: it is therefore obviously a question of relative strength whether A C will not snap in two from the small quantity of its material, sooner than A B or C D. Mr. Dredge says "the forces of tension and compression exist in the same line, the one neutralizes the other, and it is only the excess of the tensile over the compressive force that would be acting on the bars A C or B D." Mr. Dredge might as well say that the forces of tension and compression "exist in the same line" in the beam or girder itself. In the beam these forces *do not* act in the *same line*: but in *parallel* lines. But in reality at any considerable distance from the centre of the beam I should think there was no appreciable extension or compression. I mean distance measured along the length of the beam. But when the only medium by which the action can be transmitted consists in the cohesion of the particles in so small a mass of A C or B D, it is not the com[illegible] or extension in these alone, w[illegible] have to consider, and which [illegible] insignificant, but the aggregat[illegible] the forces in A B or C D, which supposed to act in parallel di[illegible] and which can only neutralize [illegible] other through the medium of [illegible] hesive force of the particles in [illegible] B D: if this should be too weak, [illegible] ture might occur in a direction [illegible] to A B or C D, or which is mo[illegible] bable, by the two parts turning ro[illegible] point N.

The whole question however of [illegible] of truss-rods when treated as a [illegible] problem must necessarily be ins[illegible] to supply any certain informatio[illegible] what would happen when a w[illegible] such as that of a railway train [illegible] *suddenly* on the bridge, for this [illegible] of the nature of impact. Fro[illegible] last Number I perceive that [illegible] phenson expects "from the [illegible] weights of the tube and the trai[illegible] there will be no vibration in his [illegible] Menai bridge. Without presu[illegible] express any opinion as to the [illegible] this bridge—for which I do not [illegible] we have any sufficient data—it i[illegible] theless perfectly certain that th[illegible] be vibration if the train comes [illegible] with anything like a rapid spee[illegible] Mr. Stephenson ever struck h[illegible] against some iron railings? If [illegible] must have seen "how great a v[illegible] a little blow causeth." I do n[illegible] what may be the opinions of the [illegible] men by whom Mr. Stephenson [illegible] assisted, but I think all opinions [illegible] little better than mere guess-wor[illegible] attempt to predict the *amount* o[illegible] tion.

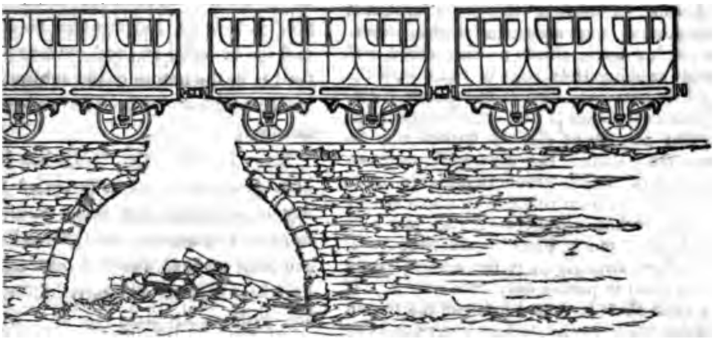
Yours,

RAILWAY BUFFERS.

Sir,—Having been on a tou[illegible] not an earlier opportunity of se[illegible] contents of your monthly numbe[illegible] *Mechanics' Magazine* for Jul[illegible] might sooner have noticed som[illegible] observations that it contains re[illegible] locked buffers.

The concave and convex buff[illegible] gested by some one under the si[illegible] of "Cymro," in the *Times* of J[illegible] 15th, seems confined to meet the

over-riding each other, as appears e taken place in the accident at rton, and would certainly tend rably to produce that effect; but further object in proposing the buffer, a term which will not o those merely denominated concave and convex. This will best be understood by the accompanying sketch (fig. 1), where a train with locked buffers is shown as passing over a ten feet chasm, made by the falling in of the crown of a bridge by the shock of the engine as it passed over it. In this case,



carriages but the last would go thout hinderance, as well as if the e not broken. The last carriage have its front wheels safely depo- the rail beyond the gap; but s hind wheels come over it, the of the carriage operating upon its eels as a fulcrum, will, from its e, more than outweigh the hinder the carriage in advance, and will p, unless these carriages be loaded d aft alternately, or some other ical arrangement be made to is difficulty. The ordinary velo- trains, aided by the weight of the portion of the carriage in advance, much in most cases to remedy fect; but if this prove all the n to these locked buffers, it will difficult so to couple the last car- a train, and perhaps even the engine in front, with the others, as to enable them to pass over such a chasm, though it may have been made previous to the arrival of the train. For broken wheels and axles, these buffers are a perfect cure.

I have not yet seen Mr. Sutton's letter of June 26th, 1845, published in the *Sun* newspaper, and therefore I cannot speak as to his views respecting buffers; but I can only say that I am much more anxious to get this locked-buffer system *adopted*, than to claim being either first, second, or third in this invention, which has, I am confident, through many stages yet unseen, to become one of the main safeguards in the history of railway travelling.

I am, Sir, yours, &c.,
GEORGE CAYLEY.

20, Hertford-street, August 28th, 1847.

(*To be continued.*)

PROFESSOR SCHOENBEIN'S IMPROVEMENTS IN PAPER.

tract of a Letter from M. Schoenbein to M. Dumas, dated March 28, 1846.

author has discovered a method by of which the following properties given to the paper in common

epared paper has much more tena- greater consistency than common

hen dipped into water it does not consistency, but is affected as parch- ould be.

3. It receives with equal facility both writing and printing ink.

4. It does not require sizing to render it suitable either for writing or printing.

5. The injurious effects produced by the chloride of lime are avoided in prepared paper.

M. Schoenbein states that his process is simple, inexpensive, and easy of application, and that the new paper offers many

advantages, particularly for bank notes and for paper hangings.

The vegetable fibre of this paper renders it possible to make of it a substance as transparent as glass, and impermeable to water. The author has made of it bottles, balloons, &c., the sides of which may be made as thin as a plate of mica.

Another property of this paper is, that it developes a very energetic electric force. By placing some sheets on each other, and simply rubbing them once or twice with the hand, it becomes difficult to separate them. If this experiment is performed in the dark, a great number of distinct flashes may be perceived between the separated surfaces. The disc of the electrophorus, placed on a sheet that has been rubbed, produces sparks of some inches in length. A thin and very dry sheet of paper, placed against the wall, will adhere strongly to it for several hours if the hand is passed only once over it. If the same sheet is passed between the thumb and forefinger in the dark, a luminous band will be visible. Hence, it is believed, that this prepared paper will answer to make powerful and cheap electrical machines.

PROFESSOR DONALDSON'S ARCHITECTURAL MAXIMS.*

Mathematics has its axioms, natural philosophy its "Principia;" but architecture is without anything of the sort. "All," says Professor Donaldson, "who have studied architecture in the works of its masters will have observed, that, although all treat of the principles which govern the art, they seldom attempt to lay down clear and definite rules couched in simple terms. The laws are not expressed in an axiomatic form, or in a series of distinct propositions." Mr. Donaldson has thought it might be "useful to the professional man to make an attempt" to "reduce some of the canons of the art to the forms of theorems briefly expressed," and hence the work before us.

Whether it is, because architecture is an art which does not admit of the axiomatic precision desiderated by the professor, or that there is no common agreement amongst mankind as to any of its principles, not stop to inquire; but certain it anything less axiomatic or *maxima* the work before us could hardly ha penned. The fact that a gentle Professor Donaldson's acknowledge and erudition should have failed s pletely, as in our judgment he has do perhaps be taken as good evidence t fault is in the nature of the subject, in the professor who has underta handle it.

Mr. Donaldson's "Maxims" have been more correctly styled " vations, Original and Select;" and word "Desultory," or "Miscella had been prefixed, the true characte have been still more clearly indicate are well worth place in the col for though but few can be consider the rank of established truths, they a least exceedingly suggestive of usefu tion. Indeed, so little have they in the character of "Maxims" that not fix on more than a dozen or se are not more or less questionable, ei unsoundness or uncertainty. Let a few specimens at random.

"V.

"* * * There *can* be onl orders of classical architecture more."

Why? Because "there are three pal gradations in all objects; thus in there are the tall, the short, and th between the two; the strong, the we the mean between the two." Becau are also "three primitive colours" "degress of comparison"—and (*risum tis*) because "the crust of the mainly composed of three materials, argil, lime!!!"

What any of these harmonic tri any other triads whatever, have to the number of orders of which architecture is suceptible, it would pu Œdipus himself to discover. Ther common principle of relationship w between them.

Why not *five* as well? For has n

* Architectural Maxims and Theorems in Elucidation of some of the Principles of Design and Construction, &c.; and a Lecture on the Education and Character of the Architect. By Thomas Leverton Donaldson, M.I.B.A., Professor of Architecture in University College, &c., London, 1847. 8vo. pp. 105. Weale.

beau ideal of organic construction, ers, and five toes, and five senses,

en? Because there are seven stages life, seven days in the week, seven the gamut, seven champions of dom, seven hills in Rome, &c., &c. *can* be" of the Maxim is the more that in point of fact ancient or architecture was divided by the themselves into *five* orders, the n, the Composite, the Ionic, the nd the Tuscan. Mr. Donaldson lls us, that the "Tuscan is but a tion of the Doric, and the Compo- amplification of the Corinthian— ions, not distinct ideas." Be it are they orders as distinguishable others as 1 from 2, or 2 from 5.

"VII.

three Classic Orders contain all the ital principles of the æsthetics of Architecture; but architecture ands *more* than the three orders."

are we to reconcile this with the " of Maxim V. If ancient archi- ould have no more orders than three, ot modern architecture in the same ? What principle of beauty or fit- here which could be true in the time les, and yet false in the age of Vic- We have always understood that nciples were of all time—everlast- immutable.

"XLVII.

h edifice, having its peculiar appro- demands that the impress of its re character should be visible in its The imposing and solemn temple— ndid and commanding regal palace— ellished residence of the noble—the prison—the cheerful theatre—should tely announce their purpose and on. If not, where is expression in ure?"

ere," indeed? Yet, here we see essor himself recognizes five distinc- as being requisite to "expression in ure," to say nothing of several others ight readily be suggested. What comes of the "classical" three, ccording to a previous "maxim," embraced everything essential? And what of the professor's notable reasons for it—the "silex, argil, and lime" reasons, more especially?

"CXXIV.

"Strength sufficient (for the immediate purpose) is not strong enough; therefore, it is better to have too much solidity than too little."

Interpreted literally, this means—that "strength sufficient," is *not* strength sufficient. The reader can readily guess at the better meaning which is hid under this oracular verbiage; but what that better meaning is, he only learns from the two other "maxims" which follow.

"CXXVI.

"No wall nor framing, nor, in fact, any piece of construction, ought to be charged with more than two-thirds of the load which it is calculated to bear. On railroads, where the load is variable, and concussion takes place, the law is one-third."

"CXXIX.

"It is not the *fracturing* weight which is required in practice, but that weight which will not injure the material."

The three "maxims" last cited, taken together, make good enough sense; but is it not a poor maxim which requires the help of two others to make it intelligible?

Of the better things in the collection—though with as little pretension as may to the character of "canons of the Art," the following may serve as specimens:

"XVII.

"The works of the ancients were founded upon the finest perception of fitness; yet the rules, which guided them, are not insuperably binding on the moderns. 'To look back to antiquity is one thing, to go back to it is another,' says Colton. And how full of truth is Bacon's sentence on the same point!—'Antiquity deserveth that reverence, that men should make a stand thereupon, and discover what is the best way; but when the discovery is well taken, then to make progression.'—*Advancement of Learning*.

"XLIX.

"How fine and striking is the description of a private residence given by Wotton at the commencement of his 2nd part!—

'Every man's proper mansion-house and home is the theatre of his hospitality, the seat of selfe-fruition, the comfortablest part of his own life, the noblest of his sonne's inheritance, a kind of private princedome. Nay, to the possessor thereof, an epitomie of the whole world.'

"LXIII.

"The eye of the ignorant or vulgar cannot appreciate many of the nice '*nuances*' essential to beauty. Woods, with his usual penetration, observes, that 'It is quite a mistake to suppose that a variation of form, not immediately perceptible to the eye, must therefore be useless. Every artist has felt, that these slight changes influence the charm of the composition without being themselves obvious even to a skilful observer.'* (vol. i. p. 337.)

"LXIV.

"If a difference of size in parts or details exist in a building, and be not discoverable unless one takes a compass, a rule, a square, or a level, they are no longer defects. Buildings are not made for measurement, but delight. When these discrepancies escape the eye, and minute examination can alone detect the irregularity, the beauty of the whole does not cease to affect us. In the Pantheon the angular columns are anti-Vitruvian, being smaller, instead of larger, than the others. At the top of the pediment there is a double modillion; and on one side of the sloping cornice twenty-four modillions, on the other twenty-two. 'Bravo,' says Milizia, 'to him who has counted them; but più-bravo to him who turns up his nose at such microscopic criticism.'

"LXXVII.

"The life of an architect is one of continual reasoning: no two buildings, which he may be called upon to design or contemplate, can be precisely alike. It requires therefore an exquisite susceptibility, unwearied patience, and sound judgment to know in what respects they differ, and how the necessary difference should be, or has been, satisfied."

"The following are of the exceptional class—the 'few and far between,' strictly axiomatic, just, and true:

"L.

"All voids and solids should be on their respective axes throughout: in plan for beauty—in elevation for strength.

"LXXVI.

"It should be the purpose of the architect to allow no day to pass without adding a sketch to his collection. His motto should be with Titus: 'Nulla dies si[n]
'For there cannot be a more bane[ful]
observes George Moore, 'associa[...]
initiation into art, than the [...]
dogma, that the aspirations of ge[...]
not be trammelled by the labour [...]
(p. 35.)

"LXXXII.

"To be a good architect one m[...]
good designer: but a good design[...]
necessarily a good architect. Vitr[...]
tinctly says: 'Architecti scientia n[...]
fabricâ et ratiocinatione.' (b. i. [...]

"LXXXVI.

"He cannot improve in his a[...]
not conscious that he is far from p[...]
'I am diffident,' said the celebrat[...]
Watt, 'because I am seldom cert[...]
am in the right, and because I pa[...]
to the opinions of others, where I t[...]
merit it.'"

To the "Maxims" there is adde[d]
stance of a Lecture delivered by [...]
Donaldson to the pupils of the U[...]
College "On the Education and [...]
of the Architect." The "Lecture[...]
more, we apprehend, than the "[...]
to uphold the Professor's high re[...]
both as a practitioner and teac[...]
abounds in noble sentiments, alway[...]
and often happily expressed. Wi[...]
specimens from this part of the [...]
must conclude:

Advantage of Literature to the A[...]

"A general acquaintance with [...]
is useful to the Architect, on accou[...]
necessity he will frequently have of[...]
ing his ideas by words and writing. [...]
complish this with method, clearness
and even brilliancy, is a desirable, [...]
common attainment.

"Vitruvius does not suggest to [...]
chitect the gift of oratory, thinking
that the eloquence of the Architect
rather in his works than his words.
Plutarch relates of two Architects, [...]
fered themselves to the people o[...]
in order to gain the superintenden[...]
ecution of some public works, the[...]
them, more expert than the other i[...]
of speaking, enchanted the Athenia[...]
brilliancy of his address. The othe[...]
remained silent, at last said, "I, [...]
do what he has said."

Uses of Biography.

"Biography is a most attracti[...]
from its moral influence upon the
very important branch of history. I[...]
us the course, by which great men

* As in the entasis and convexities of Greek Architecture.

o eminence. It unveils some of the which incompetent men have ac- passing réputation. It shows the hrough which most must pass, ere ıy hope to excel. It marks the ;, which our art has had through all and among all nations. It hands us the noble and high-minded cha- f those, who have graced our pro- the generous sacrifices of which re been capable; their forbearance egard of low motives; their disin- ıess. Michael Angelo, in order to his independence, declined the ıttached to his appointment as ar- of St. Peter's. And one of the ıe architects, being sent by the uke of Tuscany to Naples, where ted some fine works for the King, any gratuity, saying that he had a prince by whose liberality he was ımply rewarded. The King would enied, and earnestly begged him to y object he would like. 'Give me id he, 'that antique statue, that I sent it to my prince, as a gift of his acceptance and a suitable my affectionate attachment to a master.' Let me refer you to *Lives of the Architects*, translated Cressy, and believe me, that you ıys rise from the perusal of those ten memoirs with a greater love for fession, a nobler passion for glory, disregard of gain."

Theory without Practice.

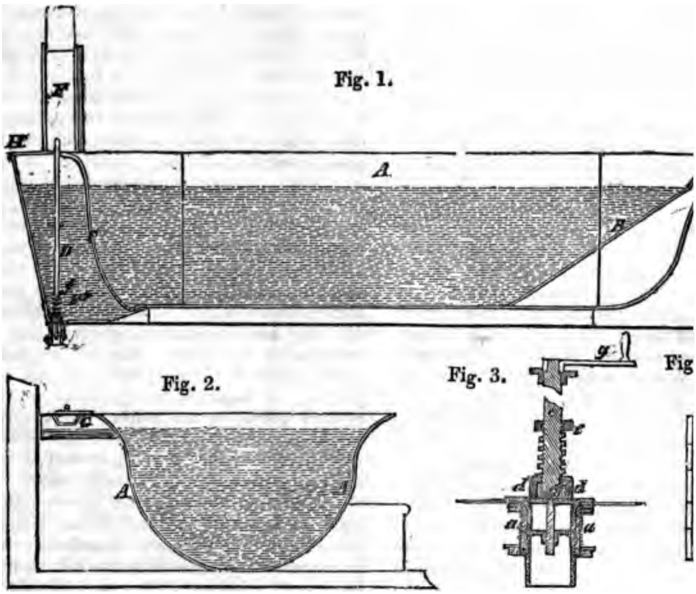
re is another class of study essen- portant to the young Architect, and *ractice*. He may have acquired all ciples which govern science. He re studied monuments, learnt the proportion, and made himself ıly acquainted with the whole sphere But, unless he be also versed in the details, it would be dangerous to ınd fatal to his employer, if he un- a building of any importance. He nscientious duty to perform: not esign well, but to execute the work undest manner and with the least Young men, carried away by the sm to which the fascinating attrac- he art of drawing gives rise, find it to enter into the details of con- ı, the cost of materials, measuring ation. But if an Architect wishes ıs all the means, by which he may is conceptions, he must go through ıal, he must visit and study works ess: and when he becomes better ed with the subject, he will find a interest in the pursuit. There is ent of his life, at which the true Architect ceases to study and acquire know- ledge: and no source is too despicable for him to gain information. The labouring ar- tisan has many mechanical contrivances, by which he may accomplish his task and ex- ecute his work. From him the Architect, whether as a student or as the more ad- vanced practitioner, may learn much. In fact we must not only be satisfied that a thing is done, but know how it is done; and eagerly avail ourselves of the knowledge of the workman. By not being ashamed of asking questions at any period of our career, we gain their respect and win their confidence. How many a young man is there, who leaves an office without any acquaintance with these departments of the profession! He com- mences business thus inadequately prepared. His very first commission involves him in inextricable difficulties. He is at the mercy of the builder, the workmen, and all em- ployed. A sense of his ignorance in this respect preys on his mind. He resolves to devote his energies to make himself thoroughly versed in the practical details of construction, and he passes years and years devoted to this; and thus employs time, which, had he been better trained, could have been more beneficially and honourably appropriated. He had still to learn his profession!!"

Architects and Employers.

"There are many trying circumstances which will arise in regard to the relations of the Architect to his employer. He is of course to consult his convenience, to adapt the building to his reasonable fancy, and above all to take care that it exceed not his circumstances. At the same time, when once the design is settled, he must not allow a meddling interference with the details, nor permit a man of fanciful ideas to force him to do what is contrary to good taste, and likely to compromise the character of the Architect: for he will in the end have to answer for everything that may be wrong. He must be firm, but also respectful; and being otherwise irreproachable will create a feeling of deference and consideration for his professional acquirements. We know that we owe the Pavilion at Brighton and Buckingham Palace to the low taste of George the Fourth, who insisted upon his architects building according to his whims and fancies. The consequence has been, that they deservedly bear all the blame. Had they assumed a high-minded independ- ence, and declined to undertake a work dis- reputable to their rank in the profession, it is possible that their firmness might have produced conviction on the mind of the Prince, and saved them from the obloquy, which they acquired."

TILKE'S NATIONAL ECONOMIC BATH.

[Registered under the Act for the Protection of Articles of Utility.]



Mr. Tilke, the inventor of this extremely well-contrived apparatus, is the well-known attentive and obliging superintendent of the National Economic Baths, Holborn.

Fig. 1 is a sectional elevation, and fig. 2 a cross section of the apparatus. A is the body of the bath; it is made of a single piece of metal reaching from one edge to the other. B is the head of it, which is inclined, to form a suitable resting posture for the back of the bather. C is the foot of the bath; on the outside, but connected therewith, is a separate chamber D, opening through C by a number of perforations at the lower end. E^1, E^2, E^3 are three valves, placed in the bottom of the chamber D—two of them for the admission of water, hot and cold, and the other for the escape of the waste water. Fig. 3 is a section of one of the valves; *a a* is the ་ which is fixed upon the botto chamber D; *b*, the valve; *c*, th connected to the valve disc by *e* is another nut, which is let in piece *f*, fixed to the sides of the D; and *g* a crank-handle, by ' valve is screwed up or down seat. F is a small door, by ' bather can communicate with tl ant outside, whose duty it is t and off the water, as desired, a regulate its temperature, whicl by immersing a thermometer i ter in the chamber D, by liftin *h*. Fig. 4 is a plan of the t chamber D. G is a water-tigh heating towels in; it is immer small chamber communicating water in the bath.

MESSRS. DEANE, DRAY, AND DEANE'S GRAIN, SPICE, AND SEED-CLEANSER, AND POLISHER.

[Registered under the Act for the Protection of Articles of Utility.]

Fig. 1 is a side elevation of this apparatus; fig. 2, an end elevation; and fig. 3 a plan. A A is a framework of wood, within which a perforated metal cylinder B is fixed, in an inclined posi angle of inclination being shifte sure to suit the quantity of se cleaned. In the plan (fig. 3), t

Fig. 1.

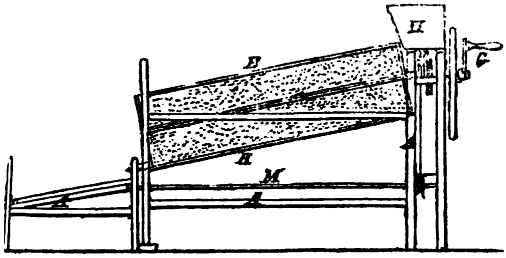


Fig. 2.

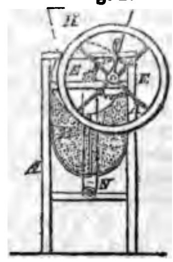


Fig. 3.

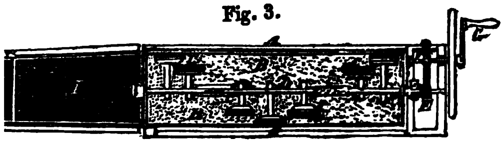
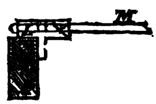


Fig. 4.



' the cylinder is removed, to show ·angements inside. C C are a se- brushes, placed upon the shaft D iral'direction, so that they follow e that would be occupied by the f a screw of the same pitch. E is n upon an intermediate shaft, the which shaft takes into a coupling ;nd of the shaft D. F is a wheel · into E, through which motion n to the revolving brushes by nk-handle G, fixed upon the fly- ;haft. H is a hopper, into which the grain, seed,¶&c., to be cleaned and polished, is placed. I is a sifter, into which the seed runs after having been cleansed from dust, &c., by the action of the brushes. This sifter derives a peculiar shaking motion from the action of a spring K, which causes it to have a constant tendency towards the end of the cylinder B, and a revolving inclined plane L, placed upon the end of the spindle M. The inclined plane is shown on an enlarged scale in fig. 4. N is a band, by which the spindle M is made to revolve.

;HENHURST'S IMPROVED FOLDING MUSIC AND READING DESK, OR EASEL.

tered under the Act for the Protection of Articles of Utility. John Talbot Ashenhurst, of 41, Upper John-street, Fitzroy-square, Proprietor.]

Fig. 1.

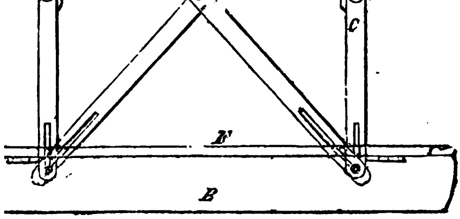
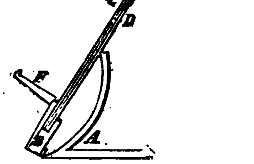


Fig. 2.



1 is a front elevation of this desk ·xpanded state, and fig. 2 an end elevation of it. A is part of a musical instrument or table, with the basement

of the folding desk B attached to it. C C are the side rails of the frame, which are jointed at *a a*. D D are diagonal rails, also jointed at *b*. E is the top rail, to which the ends of the side rails C C, as also the diagonal pieces D D, are connected, by pins *e e* passing through the slots *d d d*. The connexions of the side and diagonal rails with the basement B are effected in a similar manner. F is the rest, which is hinged to B with stop-hinges. When the desk is not in use, it is folded up by depressing the top rail, which causes the two side rails inwards at the central joinings *a* sliding of the pins *e e* within the admits of the whole of the fr folding so close together as to t the rest F when it is folded over

The superiority of this mu over those of the ordinary con will be appreciated at a glance expanded and folded up with the facility, and occupies no greate of space in the one state thai other.

REMARKS ON THE USE OF MATHEMATICAL KNOWLEDGE TO ENGINEERS, AND I THOSE WHO HAVE NOT THE BENEFIT OF A TUTOR.

(Continued from page 200.)

I shall draw this series of papers to a conclusion by a few miscellaneous observations. And, in the first place, I shall revert to a remark previously made with regard to one source of confusion and mystification perhaps more productive of embarrassment to the student than any other, namely, the total want of any clear and distinct notions as to what the symbols used in mathematical treatises on Mechanics really mean. It is a long while generally before he gets any intelligible views of the real nature of the reasoning: long, even, before he sees clearly what is meant by the "measure of a force," and how forces are measured. At the risk, then, of some repetition, I will take a few examples illustrative of what is here alluded to. Suppose the following sentence to be met with: "The attraction of the moon on the earth $\frac{\mu}{r^2}$ at the distance r." Now, this is a short way of expressing what, in plain English, will be a very roundabout affair. In the first place, the signification of the Greek letter (μ) will be generally explained by the author to be, "the attraction of the unit of mass at the unit of distance;" but we must go still further, and explain more fully. Now, the word "attraction" is, it must be confessed, an ambiguous one to the non-mathematical reader of it (and such the beginner, of course, is), and is often used in different senses, which naturally leads to the beginner's using it with no sense at all.

It is here used with reference, not to the act of attracting, manner, mode, power, or anything else of at but simply to denote and star *certain number*, namely, the nu feet which the attracted mass pa in a certain time, namely, in one which it is usually said to pass "describe" "*in consequence* attraction:" a good specimen combinations of words which c earthly information whatever. what this motion of the attracte "the consequence of," no hum knows, and no mathematicia Whether it be the man in the m self tugging away at an invisible whether the moon be a permane net, or an electro-magnet,—n make any conceivable supposi like; but don't imagine that an them has the remotest possible tion with the "mathematical theory. This number, viz., the of feet over which the attract moves during the first secon moving from a state of rest, or (more convenient when the body already is in motion) the *veloc* duced in it at the end of one s that is, *added* to what it had befo which velocity itself is again m by the number of feet over wh body would move in one second *number*, I say, is the "measure "moon's attraction," or of the "accelerating force," and is its called "the accelerating force," properly speaking, it is "the a tion." Now, of course, this acce depends upon the mass of the at body, and upon the distance betw attracted body and it. Newton's

ıection between all these quanti- ich he, having first *guessed* or *'d might be* true, afterwards veri- finding that all the motions of ›n and planets were in numerical ıce with that supposition—this is, that the acceleration men- s greater just *in proportion as* ıcting mass is greater, and is *less proportion as* the square of the between the two bodies is greater. r is expressed algebraically thus: ose that "the attraction of" a produces in a given body, and ving acted upon it for one second, ›city A (A being the number of ich, in consequence of that velo- e body would pass over in the ;ond after, if the attraction were : to act), the distance between bodies being (R) feet; and sup- at, by the attraction of another ı) on the same body, the velocity ›duced in one second, the distance ı these two bodies being (r)

en, $$A : B :: \frac{M}{R^2} : \frac{m}{r^2},$$

or $$\frac{A}{B} = \frac{M}{m} \cdot \frac{r^2}{R^2}.$$

perfectly optional with us what : choose to consider as the stand- "unit" with which to compare Let then the mass of the earth ı as that "unit": and suppose we radius as the unit of distance in ›ve equation where we may con- [as the mass of the earth, R its and A the velocity produced by 'th's attraction in one second. ; then M and R each equal to ve have for B, the value

$$B = A. \frac{m}{r^2};$$

we prefer, according to the usual ı to denote the "attraction" for :ration" produced by the unit of the unit of distance, by the Greek (μ), we arrive at the equation eleration produced by the moon whose mass is (m) on the earth, $= m. \frac{\mu}{r^2}$.

Thus then, if we choose, as we have done, our unit of mass and distance, the symbol (μ) signifies 32.2 feet.

Precisely in the same way may the plain meaning of all such equations be got at; and the student should always be able to translate into common English (though most likely very awkward and longwinded sentences) all the equations he uses. In Statics, he must get out of the habit of considering the letters P, Q, &c., as representing the dirty pieces of brass and iron which he sees in shops —and learn to look upon them as simple *numbers* (of *pounds*, or *ounces*, or any other unit) which *measure* the *pressures* or *weights*. It is these *numbers* or *ratios* which are *represented* by the straight lines in the Parallelogram of Forces, &c.: the *number* of units of length (of inches for instance) in a line A P having the same ratio to the number of inches in the line A Q which the number of units of pressure (one pound for instance) in the pressure P has to the number of units of pounds in the pressure Q.

As another instance of a very common misconception, let us take the series

$$\cos\theta = 1 - \frac{\theta^2}{1.2} + \frac{\theta^4}{1.2.3.4} - \&c.$$

$$\sin\theta = \theta - \frac{\theta^3}{1.2.3} + \frac{\theta^5}{1.2.3.4.5} - \&c.$$

Now to many students, who are not altogether without thinking what they are about, and yet have not attained to clear notions on the distinction between *things themselves* and the *numerical measures* of those things—the above series are a sad stumbling-block, and well they may be. The reader who has these misty notions, naturally asks—"How can a sine or cosine, which I know to be a number or ratio, be expressed in terms of *an angle*, which I conceive to be an *opening?*" How indeed! About the *ne plus ultra* of all conceivable absurdities would be the following equation;

$$\text{sine of a certain opening} = \text{that opening} - \frac{1}{6}\,(\text{cube of that opening}) + \&c.$$

ıbsurdity arises from considering ıbol (θ) as standing for the Eu- angle or opening, instead of for a certain numerical fraction or ratio which *measures* that angle and which bears the same proportion to *other frac-*

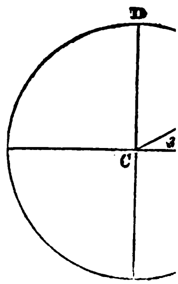
tions (the measures of other angles), which the Euclidian angles themselves do. Cos. θ is really an abridgment for "cosine of that Euclidian angle the length of whose arc bears the same proportion to the length of the radius, as the number θ does to unity."

Again the *use* of these series is seldom seen, and because the series on the left hand side of the equation is infinite in the number of its terms, the student is apt sometimes to conceive that an immense number of those terms must be taken to get anything like a tolerably near value for cos θ or sin θ. To obviate this fancy, and at the same time to show clearly the real nature of the e[...] let us take a numerical exam[...] work it out. Suppose then, we [...]vour to find the numerical valu[...] cosine of 30 degrees by means [...] series. Here (θ) means

$$\frac{\text{length of arc subtending the angl[...]}}{\text{length of radius.}}$$

and this is the first thing to find.

Now, we know that the length [...] circumference of a circle bears t[...] portion to its diameter of (π) to [...] π being nearly equal to 3.141[...] have then,



$$\frac{\text{arc AB}}{\text{arc AD}}=\frac{30^\circ}{90^\circ}=\frac{1}{3}.$$

$$\therefore \text{arc AB}=\frac{1}{3}\times\text{ arc AD}=\frac{1}{3}\times\text{ a quarter of the circumference,}$$

$$=\frac{\text{semi-circumference}}{6},$$

$$\therefore \frac{\text{arc AB}}{\text{radius}}=\frac{1}{6}\cdot\frac{\text{semi-circumference}}{\text{radius}}=\frac{1}{6}\pi.=\frac{3.1416.}{6}$$

so that here (θ) is equal to .5236.

Take only the first three terms of the series for cos θ, so that

$$\cos 30^\circ=1-\frac{1}{2}(.5236)^2+\frac{1}{24}(.5236)^4.$$

Keep only four places of decimals in multiplying, and the second side b[...] $=1-0.137078+0.003130=.866052$.

Now turn to a table of natural sines, &c., and you will find the cosine of 30° to be ·8660254, which agrees with that just found from the series up to the fifth place of decimals, and differs less from it than the cosines of 30°. 1′, or 29°. 59′, differ from the cosine of 30°.

Again reminding him that all the symbols used to denote forces, &c., &c., are nothing but simple, less *numbers*, or numerical ratios, such bugbears as he fancies—a[...] the fewer of such misty beings [...] jures up the better—I take leave [...] part of the subject, hoping it ma[...] some service.

(*To be continued.*)

THE "GREAT BRITAIN" AFLOAT!

The "possible" event of our last week's statement has actually come to pass. The *Great Britain* is afloat! We quote the following accounts from the *Times*. The first appears to have been communicated by a Dundrum Bay (perhaps Hibernia[...] respondent:

"This immense vessel, which [...] stranded at the head of the fatal [...] Dundrum since September last, is n[...]

in dock at Liverpool. Her rescue the greatest triumphs of engineer- t, as applied to the raising of a ship, upon record—not even ex- he floating of the *Gorgon* steam- ; Monte Video.

* * *

known that during the springs of th, the gigantic ship, under the of Mr. Bremner, of Wick, to ; operations for floating her had itly been intrusted, was raised en- of the sand, in which her keel had :dded, by means of great caissons, ;ls,' as they are termed by ship- suspended over rows of piles driven beach from the vessel's bow to a ut midships, and descending, by chains and blocks, as the tide rose :eamer floated. The actual impulse by powerful levers, acting on ful- the bilges, and worked by capstans purchases on the vessel's deck. appliances, however, had been vay previous to the tide of Wed- ght last (25th August), prepara- :he final attempt to remove the m the shore, where, for upwards h past, she had been resting upon s of stones under the bilges, which the workmen effectually to repair n.

ie flowing of the tide on Wednes- t, floating operations were com- y means of anchors laid out astern, arps attached to which were hove the vessel's windlasses and cap- 'hese were so far successful as to ship about three fathoms farther d, in which position she was per- remain until the following day. *:nhead*, iron steam-frigate, of 1,400 600 horse power, had come down gstown early in the week to act as ien required; and the *Scourge*, nb ship, of 400 horse power, which :d one of the royal squadron in her excursion to Scotland, had also patched to the Bay of Dundrum, ored about a mile and a half to the tward of her stranded sister. A nber of the crews of those two were aboard the *Great Britain*, efficiently contributed to the suc- ie experiment. Mr. Bellamy, Se- iter-Superintendent of Portsmouth :, and a strong detachment of rig- the dockyards both of Portsmouth nouth, were also on board the *itain*, and rendered good service. 'hursday recourse was had to the ver of the *Birkenhead*, but, owing lure of the floating apparatus in two large lighters alongside the *Great Britain*, and to the lowness of the tide, which, owing to a northerly wind, which had prevailed for some days, did not rise so high as had been expected, all the efforts made to remove the vessel were entirely unsuccessful, she not having been towed out even one foot.

"On Friday, at the flowing of the tide, about twenty minutes before noon, the final experiment to float off the ship was made, and, we have the highest satisfaction in stating, was attended with the most complete success. Two 'best bowers' had been laid out a cable's length astern, and, in addition to these, two strong warps had been spliced to those of the *Birkenhead.* By heaving on these, the mammoth steamer was towed out to seaward upwards of eighty fathoms, and into snug moorings. The ship, everything considered, made very little water—not, we should say, more than six inches an hour—a leakage which was easily kept under by ten out of the forty pumps which had been provided to meet any possible emergency, and some of which were of the most powerful description.

"LIVERPOOL, MONDAY, 3 P.M.

"At half-past 1 o'clock this day the *Great Britain* arrived in this port from Belfast, at which place she arrived from Dundrum Bay on Friday afternoon. * * * She was brought down the river opposite to the George's pier-head, where the *Birkenhead* left her, and went into the Cobourg Dock. Immediately on the *Birkenhead* leaving her, the *Great Britain* was taken by the steam-tug into the Prince's Dock Bason, and placed on the "gridiron." Her masts, rigging, &c., looked much worn from long exposure to the weather, but the general appearance of the noble ship was much better than could have been expected. With few exceptions, the upper part of her hull does not seem to have sustained much damage. On the larboard beam there were a few indentations in the iron frame-work, some of which were cut entirely through, and in the neighbourhood of the bow might be seen in two or three places similar marks of damage. She seemed to be making a considerable quantity of water, but the admirable working of the pumps was quite sufficient to counteract that evil.

"We learn that it is intended immediately to put her into a thorough state of repair, after which, we presume, she will again cross the Atlantic."

Of the ability of the Dundrum Bay correspondent to pass a judgment on the value of the "triumph" thus achieved, an opinion may be formed from the utter ignorance he

displays of the means actually employed. There were *no* " great caissons, or *camels*, as they are termed by shipbuilders," used to float the vessel off; and our specific ground of complaint against the salvors is that none were employed. The great caissons referred to were the great boxes *filled with sand*, which differ just as much from camels as a balloon does from a coal barge. From first to last nothing but sheer force has been employed—nothing but what might have been as readily had recourse to eleven months ago as now; and again we repeat, that whatever may have been the nautical skill shown in working the purchases (for which we presume the seamen and dockyard riggers must be allowed the principal credit) it is " not by means of any (engineering) ingenuity, or science, which the Messrs. Bremner have brought to bear on the task " that the ship has been saved. To say that her rescue is " one of the greatest triumphs of engineering talent " is simply absurd. Of " engineering " there has been none at all—not a vestige; and of " talent " of any sort, as little as may be.

RECENT AMERICAN PATENTS.

[Selected from Mr. Keeler's Abstracts in the *Franklin Journal* for June.]

IMPROVEMENTS IN THE PLOUGH. *John M. May.*

Claim.—" What I claim as my invention is making the land-side, the bed of the share, and the standard, all in one piece of sheet metal, cut out in the manner described, so as to afford greater stability, and to reduce the cost of construction.

" I also claim making the coulter with two points and two cutting edges, and secured to the land-side of the standard, to admit of reversing end for end, and inclining the forward point up or down, for the purpose and in the manner described.

" And, finally, I claim connecting the axletree of the guide-wheels with the beam, by means of adjustable arms, to afford a means of directing the plough, as described."

IMPROVEMENT IN WINDMILLS. *Allen Judd.*—This invention consists in placing the vanes around a vertical shaft, and at distance therefrom, and arranged with their planes tangential to the inner circumference of the rims of the wheel to which they are attached, or to some circle of less diameter, with sufficient space between each passage of the wind, which enters t from below, and acts on the inner of all the vanes and passes out; tl being surrounded with two series ters, or blinds, one series below which is on a level with the lower of the wheel, and the other series a floor, the former being thrown ope side towards the wind, by which the wheel, and those of the upp thrown open on the other side, escape of the wind after it has acte wheel.

IMPROVED APPARATUS FOR W AND AMALGAMATING GOLD AND *Daniel Asbury.*—The patentee says the ordinary and common processe separation of gold and silver from th by washing with water and amal with mercury, there has always be of both gold and silver, as well a mercury. In the hand rocker semicircular trough, usually wo hand, the quantity of sand and gra these machines can work is smal quently, when that contains but l or platinum, it cannot be worked wi and in these machines there is a g of both gold and platinum, as well silver (when that is used), bec motion is half the time in one and half the time in the other, by w gold, &c., is prevented from subsi consequently passes off with the sand. In the Burke rocker, there greater waste of quicksilver and tha metals. In the Tyrolese bowls, and gravel subside too soon to the and prevent the contact of the silver with the quicksilver. My m believe, will obviate all these practi which heretofore have attended th tion of the precious metals from t or earthy and stony mixtures; thes I effect in the following way:

" The moving frame, which sup pans, is hung to two cranks on tw one at each end, by the rotation the required shaking motion, such be given by hand, is obtained."

IMPROVEMENT IN THE ME TUNING THE METALLIC REEDS RAPHINAS, ACCORDEONS, &c. J *Ives.*—The patentee says,—" The my improvement is to simplify and the construction, and to provide the adjustment of the reeds, to m " speak;" these ends I attain by the reeds, which are attached to th of their appropriate plates, to s through the apertures in which the so that by the application of an a

e above them, their plane can be ed relatively to the apertures with the t nicety, to insure their speaking and out the best tones, the vibration being for a good tone by the pressure of ng of the reed against the presser."

s.—"What I claim as my invention g metallic reeds that vibrate within rtures for the passage of the wind, ns of adjustable pressers that act the spring of the reeds, substantially ribed.

lso claim making the slide with the spring bars or branches, substan- s described, to insure the working of e without being affected by the vibra- the reed, as described.

d I also claim making the pressure top of the reed by an adjusting or other analogous device, to regulate aking of the reed, as described."

' CLOTH MOTH HARBOUR," FOR TING BEES FROM THE MOTH, *Arndt.*—This consists of an apart- ined with cloth, which the moth and in which it remains (attracted warmth of the cloth), instead of pass- the hive.

n.—"What I claim as new, and as ention and discovery, in the above- ed apparatus, is the cloth moth har- or protecting the bees and their from the ravages of the moth; the eing induced, through the warmth of h lining, to deposit its eggs therein, of in the hive."

HOD OF PROPELLING BOATS, RAIL- CARS, &c. *Josephus Echols.*—The e says,—"The object contemplated in this invention is to economize the required for propelling boats, or other by making use of the resistance the water presents to the bow of at in its passage, and causing it ater) when being deflected, to turn l which is in connection with the wheel shaft, and thus assist the driv- ver, such as a steam-engine in pro- the boat. With the view to attain d, extra water wheels have been at the sides of the vessels, and con- with the paddle wheels, so that the of water set in motion by the pad- els should communicate motion to a wheels, which, by the connection, the power to the paddle wheels; must be obvious that this arrange- ccasions an actual loss of power, for otion communicated to the extra at the sides retards the boat by a qual to that communicated to them, he friction. But by placing the com- ng wheel at the bow, where the water must be displaced by the bow of the boat, the deflection of the water communicates available power to the wheel, which may be advantageously employed to aid in the propulsion of the boat, or applied to any other purpose."

FOR A MACHINE FOR SHAVING AND JOINTING STAVES FOR BARRELS, &c. *Jno. H. Lester.*—The patentee says:—"The dressing and jointing on rived stays by machinery, are operations which have heretofore presented much difficulty, and of the various attempts to attain these important ends, by means of rotating planes, none has, so far as I am informed, been successful. The difficulty arises from the fact of the uneven and crooked condition of the rived bolts, which must be dressed with the grain of the wood, and of equal thickness, and the necessity of jointing the curved edges of the staves, to give the bulge to the barrel, or cask, by a continuous movement. The dressing of staves has been essayed by two rotating planes—one to plane or dress the concave, and the other the convex surface; the planes being placed one forward of the other, so that the staves pass from the one to the other: but in this there is no method by which the planes can adapt themselves to the bends and crooks of the bolts. Attempts have also been made to joint the edges with rotating planes, by placing the stave, after being dressed, on a reciprocating carriage, provided with guides to cause the rotating planes to approach towards and recede from each other, to give the required bulge to the staves.

"The improvements which I have made, remove these difficulties, and consist, first, in hanging the two rotating planes, one above the other, in a vertically sliding frame, to receive the bolt from the feeding or guide and pressure rollers, and pass them to other rollers, which deliver or conduct them to the jointing operation, the frames sliding up and down, to adapt the planes to the bends or crooks of the bolts, the sliding of this frame being effected by two sets of rollers hung in the frame, one forward and the other back, of the rotating planes; and, second, in giving to the frames in which the jointing cutter heads are hung and run, reciprocating movements towards and from each other, by means of cam-grooves, eccentrics, cranks, or other analogous device, as the staves are fed forward by a positive motion; the continuous feeding and reciprocating motion of the cutter heads being made to correspond."

FOR IMPROVEMENTS IN RAILROAD SWITCHES. *Philos B. Tyler.*—The patentee says:—"The nature of my invention consists in constructing the movable part of

the switch with an additional branch rail, between which and the true switch there is an inclined plane, and a guard on the outside, so that when the switch is set wrong, the cars cannot run off the track."

IMPROVEMENT IN THE MANNER OF APPLYING WATER TO WATER-WHEELS. *J. K. Millard.*—This is for a mode of regulating the discharge of water on to that class of water-wheels formerly known as "tub-wheels," but now sometimes called "turbine wheels." The flume, which is vertical, has a bottom just above the top of the wheels, and in this there is an annular opening corresponding with the circle of the buckets of the wheel. In this groove are hinged a series of shutters, which are suspended to a ring, which, when let down, covers entirely the annular aperture, so that, when this is raised or lowered, the shutters are opened or closed, and therefore the general aperture is regulated in proportion to the separate apertures formed by the series of shutters.

Claim.—"What I claim as my invention is the arrangement of the series of shutters to regulate and direct the discharge of the water on to the buckets of the wheel, in combination with the gate to which they are suspended, and by which they are operated and protected from the too violent action of the water; this gate at the same time affording a better means of shutting off the water than could be effected practically by the shutters, as described."

IMPROVEMENTS IN REVERBERATORY FURNACES FOR SMELTING IRON. *Andrew Ellicott and John M'Crove.*—This is for an improvement in furnaces for reducing iron ores, whose object is to facilitate and economize fuel. Two stacks are placed side by side, with a blast for each, which, as occasion requires, may be diverted in such a manner that nearly the whole blast may be directed to one of the stacks, while the charge in the other preserves sufficient heat for its stage of the process."

FOR IMPROVEMENTS IN THE PROCESS FOR MANUFACTURING IRON DIRECTLY FROM THE ORE, AND IN THE APPARATUS THEREFOR. *J. F. Winslow.*—The patentee says,—"My improved process is applicable to the treatment of oxides of iron only; and this I effect in reverberatory furnaces, although some parts of the process may be applied in furnaces without the reverberatory feature.

"It has long been essayed to reduce the oxides of iron directly into the metallic state by heating the ores mixed with carbonaceous matter, with the view to produce deoxidation, and then to transfer the mass thus treated to the puddling process; but in all these, which have so far been unsuccessful, the upper stratum only of the mass of ore and carbon was exposed to the direct a the heat and flame, instead of th mass; and to avoid this evil, it h suggested to apply heat to the mas and carbon below as well as above, by the fire grate directly under the hearth, or floor, and then reverbera flame and passing it over the charge modification, while it removes the objection of the process above in introduces practical difficulties of su nitude as to defeat the contemplated

"My improvements effectually avo difficulties, and consist in exposing t of pulverised ore, mixed with carbo matter to the combined action of flame, or heat; and currents of he passing through the mass, which, passage, not only agitate the mass to mechanical liberation of the gasses but aid in evolving the gases from th and carbon, which, in their nascen combine and revive the metallic part

"The mass is then subjected to t bined action of a more intense flame highly heated currents of carburet drogen gas, that pass through the m take up the remaining oxygen of and revive the metallic particles; a the mass passes to the puddling where it is subjected to a still more heat, and to the action of jets of heated atmospheric air, to consume bonaceous matter, and free it fro impurities. For the application of proved process, I have made import difications in the well-known rever furnace, which, for this purpose, of much greater length than those he used."

FOR IMPROVEMENTS IN THE JA FRAME, FOR WEAVING FIGURED F *John Perrins.*—The patentee says the jacquard frame, as heretofore m now used, the trap boards, through the tail cords pass, and by which lifted, are each operated by separat thus requiring as many levers and operations as there are trap boards the mode of mounting to form the as at present practised, each divisio tail cords (all that pass through c board I will call a division) is in co with one colour only (it will be un that when I speak of one colour mean also the threads connected mails of one pair of lifters), and th necessary consequence, when the th one colour (or combination of colo pair of lifters) are to be used to int the picks, the cards must be shifte new card presented for each pick.

"The object of my improveme

y the structure and operation; first, iecting all the trap boards, by hori- ilides, with a vertically sliding frame, d by one single lever, so that all the ırds are lifted together, the lifting of cords being governed by the sliding rap boards, that are provided with holes through which the cords pass, when the trap boards are shifted is done by cams on a rotating shaft, by the sliding of the trap board r any other intermitting movement), ts on the tail cords, which have been y the needles, are caught and lifted; ondly, by connecting the tail cords s through one trap board with the a two different pairs of levers, so mails of each lifter of one colour, set of colours, are connected with boards, and so of the other colours. antage of this arrangement is, that l only is required for each lash, as erweaving of one colour can be by one card, in consequence of the on of the mails of each lifter of one each with two separate trap boards; y the old plan, it is necessary to shift lles to interweave the same colour, hifting of the threads of one colour r be done by shifting the needles by e of cards, in consequence of the on of all the mails of one colour, et of colours, with one trap board."

IMPROVEMENTS IN THE MACHINE ITTING THE THREADS OF WOOD i. *Thos. W. Harvey.*—The paten- :—"The nature of my invention , first, in arranging the screw blanks tinuous row, when thrown promis- into a hopper, and delivering them, one, without the necessity of an ıt, which is effected by means of two rollers, placed far enough apart to the shanks of the screws to hang y between them, so that, by their and inclination, they cause the to arrange themselves side by side, heads resting on, and the shanks between them, and thus gradually them towards the delivery end.

" second improvement consists in he blanks from the ends of the rol- ıd delivering them into a vertical ng tube, by means of a slide, which perture in it that admits the blank, its motion, and the oblique side of rture, forces it, horizontally, and in al position, to the aperture of the tube, down which it descends, at e time checking the further descent blanks between the rollers until its the aperture being so formed as to the descent of the blanks into it from the rollers before the repetition of the delivery operation.

"My third improvement consists of a pair of spring conveying fingers, which are presented to the lower end of the vertical tubes down which the blanks descend, and slightly opened by coming in contact with a projection from the lower end thereof to receive the end of the blank as it descends, and which is griped by the fingers as they are moved away; the conveying fingers projecting from a shaft, so operated by a slide and a series of cams and levers, that it rotates through a part of a circle to bring the blank in a horizontal position, and then horizontally to present the head of the blank to the gripers, preparatory to cutting the threads.

"My fourth improvement relates to the employment of gripers joined to a chuck or head, at the end of a hollow mandrel, and connected to one end of a sliding rod within the mandrel, the other end being connected with a slide governed by a cam, the sliding of which causes the gripers to take hold of the blank just within the head, to rotate it whilst under the operation of the chasing tool, when this is used in combination with a turn-screw, that slides within or on the sliding-rod, and forced towards the head of the screws by a spring, so that if the blank should turn in the gripers, in consequence of the bite in the chasing or threading tool, the turn-screw will be forced into the nick in the head, and there hold it.

"My fifth improvement relates to the arrangement of the thread cutter or chaser, and the sliding rest, the latter of which is secured to a sliding chasing frame or carriage, for the purpose of preventing the shanks of the screw from yielding while under the action of the chaser; which latter is also properly secured in an adjustable tool-holder or head, jointed by its lower end to the chasing sliding frame, the upper end sliding on a rod secured to a sway bar, one end of which is jointed to an adjusting slide, and the other governed by a cam which gives the requisite taper and point to the screw. The chasing frame is governed in its motion by a chasing cam groove on a cylinder, the groove being so formed as to move the chasing slide to carry the cutter gradually from the commencement of the thread towards the point, with a motion so regulated relatively to the rotation of the mandrel, as to give the pitch of the thread, and then moved back again for another cut, one part of the groove crossing the other for this purpose; and that part of the groove which moves the chasing slide for chasing the thread is in the form of a helix, and at

the end thereof it crosses the helix with a sudden curve to run back the chaser, and at the end of the helix the groove runs into another groove, the junction of these two being provided with a sliding switch, connected with a sliding rod within the chasing cam shaft, and so governed by another cam, called the index cam, that when the thread is chased the switch is shifted, which opens this latter groove to draw the chasing frame and chaser far enough out of the way to admit of the operation of the conveying fingers to supply a new blank.

"My sixth improvement relates to the method of adjusting the motions of the chaser to the varying lengths of blanks, and to the different form of points, so as to insure the formation of good points on the screws, by making the cam which governs the motions of the sway-bar adjustable on its shaft.

"And my last improvement relates to the mode of changing the cams that operate the conveying fingers—the griping cam and the chasing cam—by means of an index cam, which operates sliding twitches, through the intervention of sliding rods, within the hollow mandrel and the cam shafts.

"By means of these improvements I constitute an automatic machine, which performs all the operations of arranging the blanks in regular order, supplying them one by one, conveying them to the gripers, chasing the thread with any desired taper and point, and discharging the chased screw, with no other human labour than is necessary to keep the mechanism in order, and to throw a large quantity of blanks into the hopper at given intervals."

CALENDAR OF SPECIFICATIONS OF PATENTS OF INVENTIONS. FROM THE PERIOD WHEN THE PRACTICE OF ENROLMENT COMMENCED TO THE PRESENT TIME.—CONTINUED FROM P. 213.

[From the Reports of the Deputy-Keeper of the Public Records (Sir Francis Palgrave).]

THE CALENDAR.

[Of the two dates annexed to each entry, the first is the date of the patent, and the second that of the enrolment of the specification.]

James Rumsey, of Falcon-stairs, Southwark, engineer: of new and improved certain methods of applying the power of steam and water, either together or separate, as circumstances may require, to the purpose of milling, and giving advantageous motion and effects to all kinds of machines and engines upon which they may be brought to act: consisting of the following heads: 1. In constructing these water wheels in general of metal with their cuckets or floats movable upon hinges, &c., &c. 2. [...]proving the common wheel, where [...] of water is small and low, by caus[...] rims and cuckets of the wheels, which [...] be well leathered and lined within, t[...] in a case or apron of metal or wo[...] closely embraces its lower part, &c., [...] In constructing water wheels, wit[...] cuckets or floats fixed upon the ext[...] of flat metal rings, mounted upon ho[...] axes, moving through a slit in a [...] tube facing the centre or axis of the [...] while its cuckets, which are leathere[...] through the tube itself, &c. 4. In [...] the ends of specifier's improved "B[...] tube water mill" (specified pursuant t[...] of 24th March, 1790) to move rou[...] its ends in a circular case that is op[...] the axis of the tube which extends [...] trary sides of each end to the bottom [...] case, &c. 5. In removing obstruc[...] wheels arising from back water occ[...] by floods or tides, &c. 6. In giving [...]ful motion and effects by the age[...] steam to specifier's new invented a[...] proved water wheels by fixing the [...] within tight vessels immersed in wat[...] keeping the said vessels exhauste[...] steam engine of the water, &c. 7. In [...] powerful motion and effects to vario[...] chines by causing specifier's new-i[...] steam engines (hereafter described) [...] fixed horizontally with piston rods, [...] through one or both ends of their cy[...] in order that it may work different m[...] at the same time or alternately. 8. In [...] powerful motion and effects to mills a[...] machines by causing specifier's forcin[...] engine (specified pursuant to the said [...] of March, 1790) and the atmospher[...] nately to force pistons with water b[...] forwards in cylinders fixed horizon[...] otherwise, &c. 9. In giving power[...] tary motion to specifier's said water [...] by means of a steam engine applied [...] water into an air vessel, from whic[...] conducted by a tube or otherwise to [...] the wheel of a mill, &c. 10. In [...] powerful circular motion to specifier[...] invented rotary steam and water [...] that are applicable immediately in al[...] tions to every machine requiring [...] motion of a uniform power of an[...] strength, without the encumbrance [...] cessity of cocks, valves, slides, or [...] except to stop or put them in moti[...] 11. In giving powerful circular mo[...] specifier's new-invented horizontal [...] steam engine, which in its form is no[...] unlike the old Barker's mill, as desc[...] several philosophical works, the stea[...] the boiler being made to enter the to[...] upright tube of metal that becomes [...]

nachine, which is applicable to any requiring circular motion, &c. 12. 'ented steam engines for lifting, or dispersing water, and other pur- 13. In improving, by more fully ıg, the principles, constructions, and applications of specifier's boilers, steam vessels, &c., described in the specification of his patent of Nov. 6, 1788. Cl. R., 31 Geo. 3, p. 6, No. 7. Aug. 25, 31 Geo. 3; Sept. 24, 31 Geo. 3, 1791.

(*To be continued.*)

LIST OF ENGLISH PATENTS GRANTED ON SEPTEMBER 2, 1847.

Sykes Ward, of Leeds, York, gent., for ents in communicating motive power, applicable to working signals and breaks 's, and also improvements in communi- elligence, signals, and motive power by r of voltaic electricity. six months; Sep-

Madigan, of Haverstock-hill, Middlesex, ıeer, for certain improvements in railway s. Six months; Sept. 2.

Chabot, of Skinner-street, Snow-hill, ıer and engraver, for improvements in rriages and in the buffers and other apparatus connected with such carriages, Six months; Sept. 2.

Henry Davy, of Ossery Saint Mary, Devon, gent., for improvements for separating copper and other metals from their ores. Six months; Sept. 2.

Thomas Foster, Streatham, Surrey, manufacturer, for improvements in machinery for cutting India rubber, in rendering fabrics waterproof, and in making articles from fabrics so rendered waterproof. Six months; Sept. 2.

Robert Oxland, of Plymouth, chemist, for improvements in dyeing, parts of which improvements are applicable to the manufacture of metallic alloys. Six months; Sept. 2.

DESIGNS FOR ARTICLES OF UTILITY REGISTERED UNDER 6 AND 7 VIC. CAP. 65.

No. in the Register.	Proprietors' Names.	Address.	Subject of Design.
1179	George Curling Hope,	Ramsgate	Tambour and crotchet needle.
1180	George Curling Hope,	Ramsgate	Knitting and crotchet cotton.
1181	John Patterson	Wood-street, Cheapside	Belt fastening.
1182	Abram and Charles Seward	Lancaster	Hot air furnace for warming buildings.
1183	William Smith	Gresham-street	Tray for holding pins and needles.
1184	Jacob Lyons	Wilson-street	The Royal Cambridge Coa.

CONTENTS OF THIS NUMBER.

LONDON: Edited, Printed, and Published, by Joseph Clinton Robertson, of No. 165, Fleet-street, in the City of London.—Sold by A. and W. Galignani, Rue Vivienne, Paris; Machin and Co., Dublin; W. C. Campbell and Co., Hamburgh.

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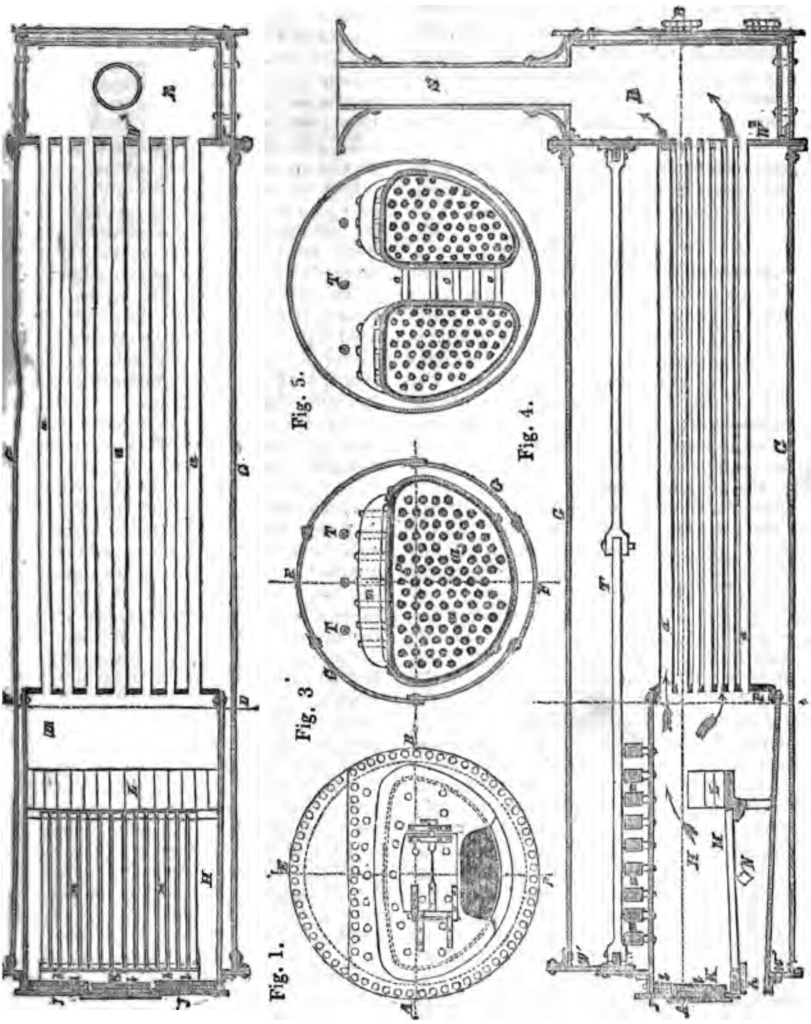
No. 1257.] SATURDAY, SEPTEMBER 11. [Price 3d.

Edited by J. C. Robertson, 166 Fleet-street.

MESSRS. FOSSICK, HACKWORTH, AND ELLIOTT'S PATENT IMPROVEMENTS IN LOCOMOTIVE BOILERS.



MESSRS. FOSSICK, HACKWORTH, AND ELLIOTT'S PATENT IMPROVEMENTS IN LOC(AND OTHER TUBULAR BOILERS.

[Patent dated March 3, 1847. Specification enrolled August 3, 1847.]

The accompanying engravings, figs. 1, 2, 3, 4, represent a locomotive boiler constructed according to the improvements which form the subject of the present patent. The advantages attending these improvements will be found stated in the course of the description; and are such as will command—if not instant assent—at least universal attention. Mr. Hackworth, one of the patentees, is, if we mistake not, the same Mr. Hackworth who figured in the lists at the famous Prize Competition, on the opening of the Liverpool and Manchester Railway; and if so, he brings to his present task a more than ordinary share of practical experience in the department of engine work to which the following specification relates:

Description.

Figure 1 is a front elevation of the boiler; figure 2 a sectional plan on the line A B; figure 3 a transverse section on the line C D of fig. 2; and fig. 4 a vertical longitudinal section on the line E F. G is the external shell of the boiler; W^1 the front plate, and W^2 the back plate (exclusive of the smoke-box); H is the fire tube, or box, which is made of a semicircular form, with the exception only that it is slightly convex at the top, as shown. It may be made either of copper or iron plates, and riveted either with copper or iron rivets, and the plates may be of any length, width, or thickness judged best. J J is the front plate of the fire-box; K the doorway. Both the front plate and the doorway are lined with double plates (*l l*) in order to protect them from the fire. L is the fire bridge. M M are the fire-bars, which rest at the near end on a slab plate *h h*, and at the far end on a ledge projecting from the bottom of the bridge. N (fig. 4) is a transverse bearing on which the fire-bars rest at the middle of their length. The furnace is riveted at top to a series of transverse iron stays *m m*, which are made of wrought iron, and may vary in number according to the degree of pressure to which the boiler is intended to be subjected. P is a thick plate, at the inner, or far end of the fire-box, and of the same nearly semi-cylindrical form, which has a flange turned out of itself all round, by means of which it is riveted to the other furnace-plates (flange inside). In this plate are a number of holes, in which are inserted the near ends of the fire tubes *a a*, which pass through the bod boiler, and are inserted at their oth mities in the back plate W^2. R is the box; S the chimney. The whole fire-box is made steam-tight, and t all round between it and the exter G is filled with water, and comn with the other water spaces of th T T are a series of wrought ir which are passed lengthways from plate to the back plate of the bo are coupled in the middle as show 4. The fire-tubes *a a* are arranged cal rows, so as to leave a free pass bottom to top between the rows. these rows, in consequence of the cular form of the fire-box, are ne of varying lengths, they are so p respect of one another that every t have an open water space on both it. By this arrangement of the tu water, as it is heated, is enabled t more freely between the tubes th boiler, with tubes arranged in the zig-zag manner; while at the same solid matters which may be separat course of the conversion of the w steam, have a freer descent to the b the boiler. When, again, it is re cleanse the boiler, this is readily ef passing straight rods down betw straight rows of tubes to the botto boiler, and stirring up the deposit are then carried off by washing. Th may have short radial flexible scr whalebone, cane, or other suitable attached to them, in order to cle the tubes in passing; but in boil tubes arranged in the order herein the deposit in the tubes is so sma for a long time to affect material heating power, whereas in boilers tubes arranged in the ordinary zig-z ner, the tubes become very rapidly in lose as rapidly their heating pow soon cease to be of any use.

Where boilers of very large din are required, a modification of the ment just described, such as is rep in fig. 5 of the drawings annexed, adopted. This modification consist in parting the fire-box and tubes d middle into two distinct sections, employing two furnaces, one to ea tion. The sections are placed at distance from one another as to leave space between them, and they are co together sideways by strong stays Each section is constructed in al

respects in the same way as the single fire-box and tubes hereinbefore described.

Fig. 6.

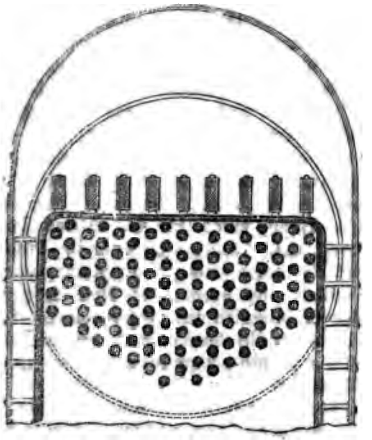
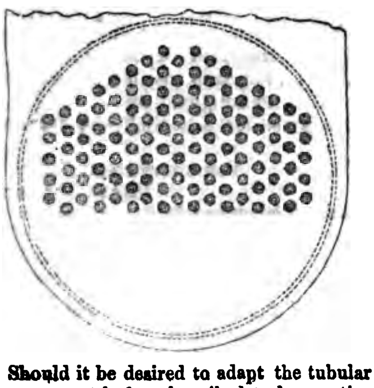


Fig. 7.



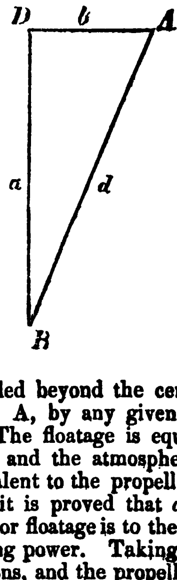
Should it be desired to adapt the tubular arrangement before described to locomotive boilers of the ordinary rectangular description, this may be done in the manner exemplified in fig. 6 and fig. 7, the former being a sectional elevation of the fire-box end of a boiler, with the tubes adjusted according to our plan; and the latter, a sectional elevation of the same at the smoke-box end.

Boilers, with the improvements before described—all or any of them—may be applied either to locomotive, or to marine, or to stationary boilers.

AERIAL NAVIGATION.

Sir,—Since inditing my answer to Mr. MacGregor, I have been induced to doubt whether the objections he made to my Archimedean Balloon were indeed "true in principle." In Sir G. Cayley's "Practical Remarks on Aërial Navigation," in the *Mechanics' Magazine* for March 4th, 1837, No. 708, I find the learned baronet demonstrating the erroneous nature of the supposition "that any propelling force of waftage, when acting in the direction of the *car*, will not tend to propel the *balloon* above it;" and Sir George proves, that when the propelling power is exerted horizontally, the cords by which the car is suspended, will bend back to a certain *limited* extent only, and this extent need not be great. Thus, in the triangle A D B, right-angled at D (fig. 1), let A be a balloon; B, the

Fig. 1.

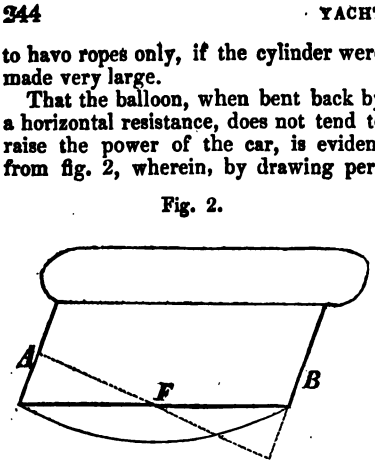


car, propelled beyond the centre of its suspension, A, by any given power of waftage. The floatage is equivalent to the weight, and the atmospheric resistance equivalent to the propelling power. From this it is proved that a is to b as the weight or floatage is to the resistance or propelling power. Taking the floatage at 10 tons, and the propelling power at 1 ton, the deflection from the perpendicular would be about 6°, and this would be the case at whatever height the balloon were placed above the car. The more flexible the connection between the balloon and car the better; for, if the connection be rigid, the car will share in the deflection, and, unless the paddles be shifted so as to continue to exert a horizontal force, the machine will rear up and fall back, as Mr. MacGregor stated my balloon would do. It would therefore be necessary to take away the posts I planned for fixing the balloon, and

to have ropes only, if the cylinder were made very large.

That the balloon, when bent back by a horizontal resistance, does not tend to raise the power of the car, is evident from fig. 2, wherein, by drawing per-

Fig. 2.



pendiculars from the fulcrum F to the ropes A B, by which the balloon exerts its elevating power on the car, we find that the leverage by which the rope A tends to raise the prow is equal to the leverage by which B tends to raise the stern. The yielding nature of the balloon might cause B to deflect less than A, in which case the prow would be depressed. Thus, Mr. MacGregor's argument against my machine, entirely falls to the ground.

From these considerations, it appears that the Archimedean Balloon need no longer be deficient in buoyancy, seeing that the cylinder may be considerably enlarged without disturbing the equilibrium of the machine in any material degree. This view of the case suggests some alterations in the build of the machine; but this part of the subject I shall not enter upon at present.

When I stated, in my reply to "Argus," that "the rude pressure of storms and tempests to which navigable balloons have been thought liable, exists only in the imagination," of course I did not mean my remark to apply to the case of a balloon riding at anchor. I think it as well to make this observation, since I find that Sir George Cayley takes into consideration the effects of storms upon balloons fixed to the earth.

It has been asserted that a rudder of any kind would be of little use to keep my aërostat always pointed in the right direction: this I have disputed; but supposing the assertion to be verified, *are not the paddle-wheels capable of steering the machine?* This, again, requires some alterations, which I defer t upon till another opportunity.

In the plan I have given paddle-wheels in a former number, be seen that the floats are dra beating the air through nearly hal volution. Of course, by alteri grooves in the guide-wheels, th can be made to beat the air thr smaller portion of their course, do so would doubtless be advantag

I cannot despair of using stea motive power, except for purely nical flying, since Sir G. Cayl proved, that "there must ever be *retically*, some bulk (of buoyant in which any species of first however sluggish in proportion weight, would find itself susp and its power adequate to prop bulk with the required velocity."

I am not aware that the argu have adduced, concerning the brium of navigable balloons, hav overthrown, but they seem to hav overlooked by some. If the phil cal baronet has reasoned unsoun if I have drawn erroneous deduc shall feel obliged to any one who so kind as to enlighten me.

"I pause for a reply," and I Sir,

Yours very respectf
JOSEPH P

Hastings, September 2, 1847.

YACHT SAILING.

Sir,—I shall conclude my obser upon Yacht Sailing by a few m neous remarks. But first allow express a satisfaction, shared in, no by your other nautical readers, t so able as Commander Shuldham be found willing to add to our kno in this department; for naval s perhaps more than any other, is in to the scattered results of expe which require to be collected a lated before sound conclusions deduced.

A cutter sailing on a wind ge carries weather-helm. When the freshens, the tendency to luff up creased in a much greater ratio indeed, the rudder would be un resist it, were its influence not by the greater resistance on the le ship section as the hull lies over

re of the wind. For it will be hat, as the plane of the keel is in- from the vertical, the resistance the after deadwood offers to round- , is more diminished than that of trance or bows to paying off the rom the wind. Less weather-helm ıffice when the stern-post is well ; for the horizontal resistance at ws is thereby diminished in conse- e of the depression of the run. ause of the easy steering of screw- led vessels, is the removal of a part of the deadwood abaft the axis ation. Theoretically, this axis which a vessel turns in tacking, ıss through the centre of gravity; ı sailing vessels, we must consider es, the beam pressure on the sails, l as the horizontal forces acting on trance and run. So that, in prac- hen the head-sails are loose, and oring flatter forward than aft, the ill, in fact, be much abaft its theo- position; for the first of these is always less powerful than the l.

helm should never be shifted too ıly; first, because the gradual ex- ıg of a force, when applied to a astic body, is more efficient in ing motion among its particles hen concentrated in the manner of pulse, just as sand, which yields to ıl pressure, will resist the greater f a smart blow; and second, be- before the water can be moved ntally, the way of the vessel is much decreased by the rudder. While on this point, I am reminded of the backwardness of many sailors to take immediate advantage of stern-way. When a vessel in stays unfortunately acquires stern-way, the fact is soon made known by a certain indescribable *dead* feeling; and the helm should be instantly reversed in inclination. The most obstinate sail-ing-boat may often be put about by a ready alteration in its centre of gravity; namely, by increasing the weight for-ward during the first part of the process, and by increasing it aft at the instant that the head begins to pay off on the new tack. I think that the day is coming when cutters will carry their keels paral-lel to the water-lines, and when the pre-sent tendency to lengthen the forefoot will be even stronger and more general. This will render necessary more head-sail, either by shortening the gaff and lengthening the hoist of the mainsail, or by prolonging the bowsprit, however in-convenient. I would ask Commander Shuldham, if he is assured that the in-creased effect of his convex sail was not owing merely to the flatness of the plane portion of it, and would not have been lessened had the convex part been cut away?

I am, Sir, yours, &c.,

JOHN MACGREGOR.

P.S. It is hardly necessary to call attention to the mistake of your printer, in substituting "balloon" for "rock-et" in my last communication.

Dublin, Sept. 1, 1847.

ıKS ON THE USE OF MATHEMATICAL KNOWLEDGE TO ENGINEERS, AND HINTS TO THOSE WHO HAVE NOT THE BENEFIT OF A TUTOR.

(Concluded from page 232.)

student who has arrived in the of his reading to that part of Sta- which the previous principles are l to the case of *Flexible bodies*, s the Catenary, is very likely to ne hesitation and doubts as to the ty of applying to flexible bodies conditions and equations which een proved only for *rigid* ones. st be reminded in the first place, ry flexible body in nature is really ed of an immeasurable number of r particles which are perfectly in- or rigid: in fact these small ele- y particles are the only ones which said to be perfectly rigid, for in all ordinary masses, such as beams of wood or iron, &c., the form and arrangement is easily altered by ordinary pressures, so that they are in reality flexible bodies.

Between each pair of these ultimate particles there are forces of attraction (or cohesion, or whatever name you choose to give it) acting, which are to us perfectly unknown in magnitude—and all we can safely suppose concerning them is that the direction of this mutual force is the line joining the two particles, and that the pressure on one is exactly equal but in the opposite direction to the pres-sure on the other. On these axioms as to the direction and equality of magni-

tude in the mutual forces or pressures, we can find the conditions of equilibrium of any mass of particles whatever — whether that mass be solid, fluid, or gaseous. In this case we consider each particle as being itself in equilibrium under the action of these mutual internal forces together with any given and known external forces (such as that of gravitation), which latter are supposed known in magnitude and direction. By the Parallelogram of Forces we resolve all these forces, known and unknown, into three sets along three rectangular axes: since the particle is not to move in any direction, it is necessary and sufficient that it should be incapable of moving in any of these three particular directions (for any motion in space must displace the particle along one o of these three lines): hence, al forces which tend for instance place the particle in one directio the axis of (x) must be counterac those which tend in exactly the site direction along this axis. for the other two axes of (y) and

Suppose, then, that the known (such as that of gravity) acting given particle are reduced to X, acting along the axes. If R den mutual force between this parti any adjacent one, the line joining makes angles (α), (β), (γ), wi axes: and similarly for the actio other adjacent particle, we have equilibrium of the first particle the tions,

$$X + R\cos\alpha + \&c. = 0. \quad Y + R\cos\beta + \&c. = 0. \quad Z + R\cos\gamma + \&c. = 0.$$

the &c., referring to the other actions such as R. Now if we wished to determine the conditions of equilibrium of any one individual particle we must know R, and the angles α, β, γ, &c. But if our object be merely to get a relation amongst the external forces X, Y, Z, &c., for the whole system or mass, we easily effect this by going on to c the equilibrium of the other pa for here we shall see the same f &c., entering the equations, but different sign. For instance, th librium of that particle, the acti tween which and the first we de R, gives the equations,

$$X' - R\cos\alpha + \&c. = 0. \quad Y - R\cos\beta + \&c. = 0. \quad Z - R\cos\gamma + \&c. = 0.$$

By thus writing down the equations for the equilibrium of each particle throughout the whole system, and then adding together the corresponding sides c equations, it is seen that we get ri such unknown forces as R, and

$$X + X' + \&c. = 0. \quad Y + Y' + \&c. = 0. \quad Z + Z' + \&c. = 0.$$

in which all the quantities are the known external forces.

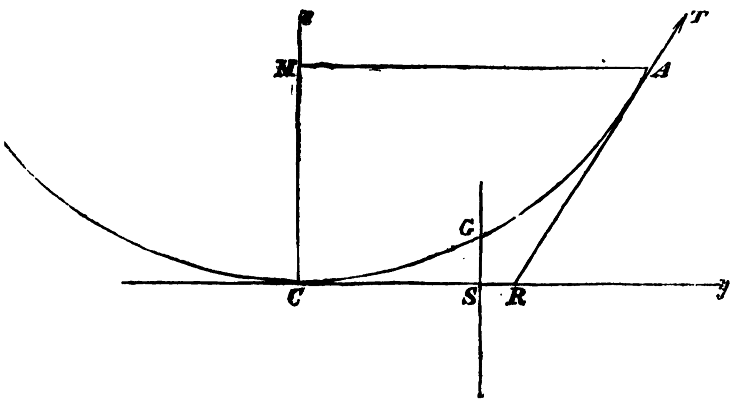
It must be carefully observed, that these last equations are not the *conditions sufficient* for the equilibrium of any one particle or of the whole system, (it might happen for instance that the force R was not sufficient to prevent the separation of the two particles between which it acts, when the external forces are of a certain magnitude—in other words fracture might occur in a solid body or dilatation &c. in a fluid): but they are *some of the necessary consequences when there is equilibrium.*

We have taken a system of "particles"—that is, have supposed that the bodies, whose equilibrium we are considering, to be so small that when one point in them is at rest the whole is at rest—in short, that there can be no such thing as rotation round a fixed point in the particle. As we have nothing to do with any such things in nature ho we must, if each of these bodies posed to be absolutely at rest, go the other equations, viz., those s by the consideration of "coupl "moments." By going through cisely similar process (and whic be found in the 3rd chapter of *Mech. Phil.*) it will be se although we cannot determine t ditions of equilibrium for any pa body of the system (any furth writing down equations contain known quantities), yet we obta tain relations amongst the known which are *necessary results* of th librium if it exists, though not s for that equilibrium.

The relation thus obtained, is t equation or equations of "coupl moments, as would be obtained whole system of internal action left entirely out of consideration

lation, obtained above, is, that "the aical sum of all the forces resolved the axes shall each = zero;" the relation is, that "the algebraical f all the moments *round any point ver* shall also = zero." This last ition requires a little further ex- ion. In forming the equation of nts for any one rigid body of the we are considering, the point which the moments are estimated he course of the *mechanical* rea- , necessarily taken *in the rigid tself*, or rigidly connected with it. is easily seen that the *same alge- l equation* or relation holds *for ultiple* of the resultant moment, that is, we may suppose the point about which the moments are estimated to be taken outside of the rigid body. In fact, it is obvious that such equations as $Xz - Zx = 0$, $Yx - Xy = 0$, and $Zy - Yz = 0$ remain true if the co-ordinates x, y, z are changed into mx, my, mz, *i. e.*, if the origin be taken differently, the new axes of co-ordinates however remaining parallel to the original ones. We are at liberty then to refer all the equations of moments for each individual body, to one common origin or point, which need not be connected with any of the bodies.

We shall now, as an example, apply these considerations to the case of the Catenary.



ording to the usual notation, let rizontal tension at the lowest point chain be equivalent to the weight length (c) of the chain, which is sed to be of uniform thickness: f (s) denote the length of the por- f the chain CA, the weight of this n will be proportional to (s). Let ote the tension at A in the tangent t point, AR, which makes an angle ith the axis of (x), that axis being upposed vertical. The portion of CA is composed of an immense r of links, each of which is kept by its own weight together with nknown tensions of the adjacent Now by the principles just set we necessarily have the same rela- mongst the external forces acting C, as would exist were they of themselves keeping the chain at rest, without any reference at all to the internal forces. These external forces are, (1) the weight of each link, (2) the tension at the lowest point, (3) that at the point A. These two latter forces are considered *external* inasmuch as we supposed all the rest of the chain removed, or at least not included in our inquiry as to the equilibrium of the portion CA. All that we have now to do is to resolve all these forces, and take their moments just as if the body were not a flexible one.

Resolving vertically, then we have the equation. Sum of all the separate weights of each link $- \mathrm{T} \cos \alpha = 0$; or weight of $(s) - \mathrm{T} \cos \alpha = 0$.

Resolving horizontally, tension at $\mathrm{C} - \mathrm{T} \sin \alpha = 0$; whence we easily have,

$$\frac{c}{s} = \frac{\text{tension at lowest point C}}{\text{weight of length of chain } (s)} = \frac{\sin \alpha}{\cos \alpha} = \tan \alpha = \frac{dy}{dx},$$

which is the equation to the curve. The tension at A is equal to

$$\frac{\text{weight of }(s)}{\cos\alpha} \text{ or weight of }(s).\times\frac{ds}{dx}.$$

So far then as merely finding the equation to the curve, we have no occasion for the equation of moments. This however will serve us to find tl of gravity of the portion of the cl for let $\overline{x}$ and $\overline{y}$ be the co-ord G the centre of gravity. Thei the moments round the lowest for instance. Sum of the mome the weight of the links = momei sion T.

$$\begin{aligned}\therefore \text{weight of }(s)\times \mathrm{CS} &= \mathrm{T}\,(y\cos\alpha - x\sin\alpha)\\ &= \text{weight of }(s).(y-x\tan\alpha).\end{aligned}$$

$$\therefore \mathrm{CS} = y - x\tan\alpha = y - x.\frac{c}{s};$$

where (x) and (y) are the co-ordinates of A. Knowing $\overline{y}$ therefore we can determine $\overline{x}$ from the equation to the curve. The same might have been obtained, of course, by taking the moments round A instead of round C, and this would have also been shorter as not involving the elimination of T. The co-ordinates for the centre of gravity thus found agree with those found by different methods, which may serve to convince those who have any doubts as to the use of these "equations of moments" when the bodies themselves are flexible. A little attention however to the preceding remarks, will show clearly the grounds on which such usage is established. In the same way might be found the centre of gravity of any curve kept at rest by a system of equal parallel forces applied to each point of the curve, together with other external forces.

It will be observed also, that we have availed ourselves of the very same circumstance to get rid of unknown forces in considering the equilibrium of bodies, which we did in a former case to get rid of them in considering the motion of bodies. These inimical forces, which would otherwise prevent our attacking such problems with success, by thus waging war and mutually destroying each other, give the same vantage-ground to the mathematician which similar events do in living warfare, "internal feuds" and antagonisms allowing that to be easily seized and subdued which otherwise would be impregnable. John Bernoulli would be very apt to assert, that these internal tuggings of particle against particle, were something "real and substantial." The preceding methods are applicable to the equilibrium of all flexible bodies, and not only to them, but to fluids and gases. In the lat however expedient, rather we sl necessary for the investigation cal effects, that the unknown forces should be kept in the equ the purpose of determining the we are often enabled to do by certain laws discovered by exp as for instance Boyle's law of portionality of the pressure to sity. It is also found convenie sider the pressure at any point mass as a function of the co-or that point, and as varying by i tible degrees from one point to By a very simple process the for the equilibrium of any port fluid are formed, in which the tials of the pressure at that point to take the place of such forces a former part of this paper—anc the aid of the integral calculus circumstances of the equilibriu vestigated. It should not be however that in such equations

$$\frac{dp}{dx}=\rho X,\ \frac{dp}{dy}=\rho Y,\ \frac{dp}{dz}=\rho Z$$

the pressure (p) is simply that have hitherto called the mutual force between two adjacent part that we might, just as in th cases, eliminate all these pressu to get a relation amongst the *kno* X, Y, Z, &c.: and that the on this is not done, is that this pressure is precisely the very we wish to determine by mea relations with *known* quantiti reader may ask why this is no the case of solid bodies as w fluids? to which we can only that we are not nearly so well a with what takes place in the ir solids as we are with the law

ission of pressure in fluids, and
›m the very nature of the case we
ıble to experiment directly on the
so well as in the other cases. It
ly probable, however, that the
ll come when it will be as easy to
he exact pressure in the interior
lid body whose nature is known,
now to do the same for any point
interior of a fluid such as water.
hole question of the strength of
ls, as well as the still more im-
and intricate questions of the
ssion of heat and light through
ıasses, renders it indispensable
s problem should be solved be-
can learn anything certain as to
le in which such kinds of motion
pagated.

SHFORTH'S EARTHWORK TABLE.

–The reviewer in the *Mechanics'*
ine, p. 139, has fallen into a mis-
supposing that I had not observed
uliarity of the point from which
ghts must be measured when my
s employed, as I have been care-
xplain this in articles 5, 6, and
have also deducted the top prism
nd of each of the examples. It
peculiarity that renders it possible
late the contents of the prismoid
extraction of a single number
e small table, when integral num-
feet are employed, whatever be
es and width of formation level.
r tables take the zero point in the
on level; and in parliamentary
es, it is necessary to rule a pencil
ut two feet below the line of rails
in this starting point. There
to be no objection to ruling a
ew feet above the line of rails in
ments, and a few feet below in
. In the case of contract esti-
numerous cross sections ought to
n; and it matters little whether
t from the intersection of the
r the formation level.
random instance of a combina-
33 feet width of formation level
feet height of embankment, with
f 1 to 1, seems scarcely fair, for
heard of such high embankments
ıade so steep. The slopes would
less than $1\frac{1}{2}$ to 1, and on the
d, Barnsley, and Wakefield Rail-
way they are to 2 to 1 when the height of the embankment exceeds 30 feet. Consequently, the limit of my Table, to be compared with others, may be taken at 54 feet. I adopted 65 as the limit, because it made my Table fully as extensive as those previously in use, and, at the same time, admitted of being printed on a single sheet of convenient size.

This limit is, however, a matter of very little importance, as I have shown (art. 3) that the table can be extended to heights of 130 feet by merely consulting it with half the given heights, and taking four times the tabular number. If we take two numbers not greater than 65, as 64 and 54, their halves are 32 and 27, of which the tabular number is 2132, and four times this = 8528. The number at the intersection of columns 64 and 54 is 8529—the small difference of one cubic yard arising from the neglect of fractions.

In conclusion, I may state, that the tables were originally calculated for my private use; and it was only after they had proved perfectly satisfactory to myself, that I thought of publishing them.

I am, Sir, yours, &c.,

F. BASHFORTH.

RAILWAY BUFFERS.

Sir,—Sir George Cayley does me the honour of referring to my communication to the *Times* of the 15th June last, and to pass an encouraging remark thereon. I can say with Sir George, that I feel a far greater anxiety to see the Locked Buffers adopted, than I do to contest the merit of being the first, second, or third, in the invention: I feel it a duty I owe to humanity not to relax in my humble efforts to point out the superiority of the new system of buffers, whether they be *Cayley's or Rowland's*, over those already in use. I admit that the particular case of a fallen bridge did not occur to me, and I look upon that suggestion alone as a very important feature in Sir George's plan. But it has struck me that the plan of having the buffers continually locked, as suggested by Sir George, is liable to this objection: If the engine runs off the rails while traversing an embankment, and is precipitated into the bottom, is it not to be feared that the overturning of the engine and the tender would cause the

whole train, which is thus firmly locked together, to be overturned also? On the other hand, are we not to hope that the engine with *free* buffers (but still convex and concave) would, on being overturned, snap the connecting chain, and leave the rest of the train uninfluenced and uninjured?

OWEN ROWLAND.

11, Heathcote-street, Mecklenburgh-square.

THE NEW PLANET, NEPTUNE.—AMERICAN OBSERVATIONS.

[From a lecture delivered by Professor Mitchell, of the Cincinnati Observatory. Reported in the *Eureka*.]

I proceed to the examination of the solar system, with a view to introduce the discovery of the new planet. We are indebted to Bode, of Berlin, for the discovery of a law which determines in a very singular manner the relative distances of the planets. He found that, by taking the series of numbers

0 3 6 12 24 48 96 192

and adding four to each term, making a new series of

4 7 10 16 28 50 100 196

he had an exact table of the relative distances of the planets. Our earth is placed at "10," and the other *old planets* are ranged to the order of their distances, giving the following result:

4	7	10	16	28	50	100	196
☿	♀	⊕	♂	Blank—subsequently filled by the discovery of the Asteroids.	♃	♄	Blank—filled by the discovery of Herschel.

As will be seen in the table, there was found to be an interval between the orbits of Mars and Jupiter, the law was broken—there was no planet to fill up the space. The idea occurred, that there might be a planet revolving within the orbits of these two planets, and astronomers were watching eagerly for any phenomenon that might present itself in that part of the heavens. It so happened, that at the beginning of the century, and on the very first day of the century, Piazzi, of Palermo, finds entering that portion of the heavens an object that ought not to be there, if his charts are true. It had the appearance of a fixed star, but, by its motions, it ought to be a planet. For forty days he followed it up, noting its position night after night, till finally a sufficient number of observations were obtained to enable him to determine the limits of its orbit—and behold! it filled the the extraordinary series, comple making it a perfect scale from begi end. I will but advert to the oth veries. In a few years another t added, and then another, and then making four small planets betwe and Jupiter. It was believed th would never be another found. I that the whole heavens had been and so thoroughly, that no obje have escaped the scrutiny. But on of December, 1845, we find it ar by Encke, of Driessen, in Germany had added a fifth star to the numl now we have five small planets between Mars and Jupiter.

The system being now complet out at once by means of this serie most distant of all the old plan planet Saturn. Before the close of century, it was noticed that there to be some disturbing influence exer this planet. It was found that it even in its motions; it was irregu its irregularities were induced by i lying, possibly, upon the exterior of of the planet. But no mind was fo enough to enter into an investigati causes of these phenomena at that 1781 a fortunate accident revealed tl Sir William Herschel finds a new cor when the mathematician takes up l ratus and examines it, he finds t comet is, in fact, no comet, but He finds that the object which Her revealed to the eye, was a large pl distant from the sun. This seem the last link in the mighty chain tha had been so long forging. It seem impossible to reach beyond this l this star or planet is not visible wit aid of a telescope. It is 18,000,0 from the central sun. In a little was found that this planet had alre seen years before. It was found old astronomers had remarked it, believed it to be a fixed star. T great advantages to the modern astro for they found it possible to avail th of the computations of the ancients investigations. Its movements were and it was found utterly impossibl concile the old observations with ones. In 1781, Bouvard, a Frenc nomer, turns his attention to the He finds it impossible to reconcile with the old computations, and it i sible for him to settle whether th pancy grows out of the imperfectio instruments or the action of some u force in the heavens. At length "I will reject the old—I will ac

will compute the elements of this ınd compute the tables by which I guided." These tables were com- but in a few years we find the com- .d the observed planets again disa-

The planet was getting in advance nputed place—it was getting farther sun than it ought to be.

'ly as 1833 we find the astronomer bserving with great accuracy the ›ns of this planet, and after attempt- ıfluence of every force that could ht to bear upon its movements, he at the planet had increased its dis- m the sun twice the distance of the om the earth. What power was ıcealed in the vast depths of space, .d exert such an influence over this

ong time no mind dared to touch the . At length a young astronomer rises, ı to fame, but with a mind capable of all the difficulties involved in any questions. I refer, of course, to r. He began by taking up the ıts of Mercury. He was dissatisfied ; old computations and the old nd he ventured to begin anew, and ate on an entire new set of tables. ese new tables, he predicted the *nstant* when the planet Mercury, on of May, 1845, would touch the sun ›p across it. The time rolls round ; planet is to be seen, and his pre- 'erified or confuted. The day ar- ıt alas! for the computer, the clouds . their dark curtains, and veil the ı his sight. Our own observatory been finished; and if the audience nit, I will state briefly my own ob- ıs upon the planet. I had ten long en toiling. I had commenced what l to be a hopeless enterprise. But saw this mighty telescope erected; ljusted it with my own hands. I ıputed the precise time when the 'ould come in contact with the sun's l the precise point where the contact ıke place; but when it is remem- at only about a thousandth part of s disc enters upon the field of the e, the importance of directing the ›nt to the right point will be real- 'ive minutes before the computed the contact, I took my place at the ›nt. The beautiful machinery that he telescope with the sun was set in and the instrument directed to that :he sun's disc at which it was antici- e contact would take place. And ıat, with feelings which no one in lience can realize. It was my first effort. All had been done by myself. After remaining there for what seemed to be long hours, I inquired of my assistant how much longer I would have to wait. I was answered *four minutes*. I kept my place for what seemed an age, and again inquired as before. He told me that but one minute had rolled by. It seemed as if Time had folded his wings, so slowly did the moment crawl on. I watched on till I was told that but one minute remained, and within sixteen seconds of the time I had the almost bewildering gratification of seeing the planet break the contact, and slowly move on till it buried itself, round, and deep, and sharp, in the sun.

I refer to this fact for two reasons: first, to verify Leverrier; and second, to impress on your minds the desirableness of locating our observatories in different parts of the earth. No European astronomer could have made this observation, because in their longitudes the sun would have set previous to the contact of the planet with its disc. I had the gratification of furnishing these observations to Leverrier himself, who reported upon them to the Academy of Sciences. The triumph of Leverrier was complete. It was after this that Arago, seeing the characteristics of his mind, said to him, "Take up the movements of the planet Herschel, watch them, analyse them, and tell us what it is that causes them." Leverrier throws aside all other employments and gives his mind to the investigation of this subject. He begins entirely back. He takes up the movements of the planets Jupiter and Saturn, and investigates them anew, he leaves nothing untouched. Finally, after having in the most absolute manner computed all the influence they exercise upon the planet Herschel, he says, "I now know positively all existing causes that disturb the planet, but there is an outstanding power that disturbs it not yet accounted for, and now let me rise to a knowledge of that outstanding cause." He did what no other man ever had attempted. He cleared up all difficulties, he made all daylight before his gaze. And now, how shall I give to you an account of the train of reasoning by which he reached out into unknown space and evoked from its bosom a mighty world? If you will give me the time, I will attempt to give you an idea of his mighty workings in the field of science.

In the first place, let it be remembered that the planets circulate through the heavens in nearly the same plane. If I were to locate the sun in the centre of the floor, in locating the planets around it, I should place them upon the floor in the same plane.

The first thing that occurred to Leverrier, in looking for the planet, was this: he need not look out of the plane of the ecliptic. Here, then, was one quarter in which the unknown body was to be found. The next thing was this: where is it located, and what is its distance from the sun? The law of Bode gave to him the approximate distance. He found the distance of Saturn was about double that of Jupiter, and the distance of Herschel twice that of Saturn; and the probability was that the new planet would be twice the distance of Herschel; and as Herschel's distance is 1,800,000 miles, the new planet's would be 3,600,000. Having approximated its distance, what is its periodic time?—for if he can once get its periodic time, he can trace it out without difficulty. According to the third of Kepler's laws, as the square of the period of Herschel is to the square of the period of the unknown planet, so is the cube of the distance of Herschel to the cube of the distance of the unknown planet. There is only one term unknown. The periodic time of Herschel we will call 1, and its distance 1, and by resolving the equation, we find the periodic time of the new planet to be a fraction less than three times that of Herschel, or about 220 years. Now, if it be required to perform 360 degrees in 220 years, it will perform about a degree and a half in one year. Only one thing more remains to be accomplished. If it is possible to get the position of the unknown body at *any time* we can trace it up to where it should be in 1847.

First, then, let us suppose the sun, Herschel, and the new planet in certain fixed positions, which we will represent as follows:

☉	♅	£
Sun.	Herschel.	Unknown, or Leverrier planet.

It will be observed that a line drawn out from the sun to the right will pass through Herschel, and if continued, will intersect the new planet. It is very apparent when these three orbs occupy the position assigned them above, the influence of the unknown planet upon Herschel will be exercised in the highest degree, and consequently that Herschel will be drawn farther from the sun at that juncture than at any other; and if we know where *Herschel* is when this effect is produced, by prolonging the line through Herschel outward, it must pass through the new planet. The delicate observations upon Herschel gave this result, and showed when it was that it was swayed farthest from the sun. By taking the place occupied by the planet at that increasing it onward one degree per annum, we can point out the must occupy at any given period. tember last we find Leverrier con ing these results to his friends i They are provided with charts, every observed star is mapped do any new object presents itself in th it is immediately subjected to a ri tiny. On the very night on whi rier's letter had been received, w telescope directed to the designa in the heavens. A stranger app has only the aspect of a fixed sta did the eye watch that night, but r was found. When twenty-four ho round, and it was once more possi the instrument upon this strange had moved in the precise degree a tion computed. The new planet w The news spread with the utmos throughout the world, all Europe trified, and soon the intelligence cr waters. Our telescope was direct object. All had hitherto failed, n ever seen it round and planet-lik disc. The evening finally came the examination. Time moved on wings, but twilight faded away a and I took my seat, with my as the instrument. I directed the tel that point of the heavens. I fo stars in the field of view. The brought to the field of view of t ment, and pronounced to be a fi and so with the second. The brought forward, and before it ha the centre of the field, I heard the tion, "There it is!" and there i bright and beautiful as Jupiter Here was a result not attained by instrument in the world. When that a body is a planet, then, an then, do we find the disc. The g of our instrument had seen it, bu recognise it.

Before five minutes had elapse crometical wires pronounced its di be 40,000 miles.—Here were res as no previous one had attained. I it, because I think it is right that country, which has but just comm career in this science, should kno her due; and I trust the day is no tant when we shall become as disti for our proficiency, for our learnin researches, and for our efforts in astronomy, as we have hitherto bee profound neglect of everything bel this sublime science.

THE "GREAT BRITAIN."—THE TRUTH CONFESSED.

We were much amused by the appearance, in the *Times* of Monday last, of the following paragraphs:

"We perceive nearly all the accounts, mentioning the extrication of the *Great Britain*, award the credit of the accomplishment of that feat to all *but those who assisted most in that eventful work*—we mean that the names of Mr. Bellamy, Assistant-Master Attendant of Portsmouth Dockyard; Commander Ingram, of Her Majesty's ship *Birkenhead*: and Commander Caffin, of Her Majesty's ship *Scourge*, are not even mentioned in some prints which have published most about this affair, or, if mentioned, so casually as scarcely to engage the notice of the reader, and their ships alluded to only as mere tugs.

"*All this is very unfair;* as we know that the first-named of the above scientific gentlemen, and the party of 60 riggers and shipwrights under his command, went on board the *Great Britain* on the 10th of August, and continued to live on board, and work—watch and work—both night and day, until she was afloat, and navigated her, in tow of the *Birkenhead* steam-frigate, to Liverpool.

"The following acknowledgment of the talent displayed and services rendered by Her Majesty's officers and men from the Lords of the Admiralty, will, however, be some little reward for the untiring perseverance exhibited by them in the pursuit of their arduous and responsible labours:

"'Admiralty, August 31.

"'Sir,—Having laid before my Lords Commissioners of the Admiralty your letters of the 28th, 29th, and 30th instant, I am commanded by their Lordships to acquaint you that they have learnt with much satisfaction that the assistance afforded by yourself, your officers, and ship's company, together with those of Commander Caffin, and the officers and crew of the *Scourge*, aided by the skill and labour of Mr. Bellamy, and the dockyard party and men of the *Victory* under his orders, *have proved effectual in the removing the Great Britain from the beach in Dundrum Bay, and in finally transporting that vessel to Liverpool.*

"'My Lords are aware of the extreme toil undergone by all engaged in this work; and the persevering zeal and good conduct of all parties employed are thoroughly appreciated by their Lordships.

"'I am, Sir, your obedient servant,
"'W. A. B. HAMILTON.

"'To Commander Ingram, Her Majesty's
"'ship *Birkenhead*, Liverpool.'"

Why, what journal was so forward as the *Times* itself in awarding the credit of the feat "to all but those who assisted most in the eventful work?" Was it not the *Times* itself which first described it as one of the greatest triumphs of *engineering* talent, as applied to the raising of a stranded ship, upon record? And what have been all the other accounts of the affair which have since appeared—*with one exception*—but echoes of the same ignorant and foolish praise? The single exception to which we allude, is the *Mechanics' Magazine*, which was the first and only journal to protest against the credit awarded by the *Times* and all the rest of the press to the *engineer* salvors, and to put in a word for the seamen and dockyard men employed on the occasion. We repeat the words we used last week:

"Whatever may have been the *nautical* skill shown in working the purchases (for which, we presume, the seamen and dockyard riggers must be allowed the principal credit) it is not by means of any engineering ingenuity or science which the Messrs. Bremner have brought to bear on the task, that the ship has been saved. To say that her rescue is 'one of the greatest triumphs of engineering talent' is simply absurd. Of 'engineering' talent there has been none at all—not a vestige; and of talent of any sort, as little as may be."

We adhere to these words, with but one slight qualification. The last member of the last sentence should have run thus:—"and of talent of any sort on *the part of the engineers*, as little as may be." The context of the passage shows that we did not mean to say but that there might have been "*nautical* skill," and plenty of it, exhibited on the occasion.

The *Times* has followed up its (not very candid) recantation by the publication of an exceedingly interesting narrative of the operations, furnished by "An Eye-Witness."

We subjoin the main parts of this narrative entire; first, because it is well deserving of more permanent record than the pages of a newspaper; second, because it enables us to correct some errors in previous statements; and third, because it confirms, upon the whole, in a very remarkable manner, the views which we have expressed on the subject. The reader will perceive that the notable sand-boxes of the Messrs. Bremner were of little or no use at all till they were *emptied of their sand*, and converted into camels; and that, as camels, they might have done good service, but rendered none, because most of them were leaky, and none of them made fast enough to the vessel (not much "engineering" in this, surely). When we said (ante p. 234) that there were no camels employed, we did so because in none of the statements which had appeared up to that time, had any mention been made of the conversion of the sand-boxes into camels; that was a piece of information kept

back till the present week, and furnished at last neither by Captain Claxton nor the Messrs. Bremner. The reader will see further, from the account of the "Eye-Witness," that, in the end, the whole of the "engineering" efforts so much boasted of, went literally for nothing; and that, had it not been for the tough sinews of a body of our hardy tars—"*such a heave*," to use the words of the narrator, "as sailors alone can make"—and but for the help also of a not less efficient pull from a pair of powerful steam-engines, the *Great Britain* might still, at this moment, have been laying imbedded in the sands of Dundrum Bay:

"On Monday, the 23rd of August, Her Majesty's ship *Birkenhead* took up her station for the second time in Dundrum Bay, about a mile and a half from the *Great Britain*. She brought with her two lighters, which she had taken in tow off Carlingford Lough, and cast them off, anchoring herself, and sending her boats to tow off the lighters without loss of time towards the *Great Britain*, together with a party of men in aid of the operations on the beach. Her Majesty's ship *Scourge* hove in sight early on Tuesday morning, and anchored about a quarter of a mile outside Her Majesty's ship *Birkenhead*. Her men were soon sent on board the *Great Britain*, contributing their welcome and much required services along with their comrades of the *Birkenhead*. These had been this day engaged in transporting the spare crew of the *Great Britain* from her deck to that of the *Birkenhead*, whereby the great ship was relieved from the weight of four tons. Next day the carpenters of the *Birkenhead* and the *Scourge* were busily engaged in making the temporary rudder and preparing the lighters for their position alongside the *Great Britain*. This position was to be under large logs of wood stretching out from the ports, called outriggers, kept down by large timber shores. Others of the ships' crew were employed in securing the "camels," *which, however they might have served as levers when filled with sand, were ill adapted to the work of lifting the ship as now applied; for, being neither wind nor water tight, they were most of them useless as they were unmanageable.* Others were labouring heavily at the pumps. The tide rose high, and it was whispered that the gallant Captain Claxton, whose energy is no less conspicuous than his judgment, had determined, if possible, to heave off his heavy charge upon the hawsers and cables of the iron ship itself. Surprise and anxiety, mixed with misgivings, accompanied the announcement. The *Great Britain, lifted by the lighters, camels, empty barrels, and rafts of wood*, evidently moved, and very slowly yielded, and only very little to the strain employed. All was animation, hope, and joyful expectation, every heart responding to the captain's hearty cheers. Darkness came on—a sudden crash was heard as the falling in of a roof, and now a noise like the report of cannon announced the failure of the blocks of wood, the wedges, and the camels, which, bursting from their hawser-bands, *by which, under the engineer's directions, they had been too lightly fastened, became useless. It seemed, in fact, as if the enormous body with which they had to deal had surpassed their calculations and baffled their energies.*

"The Leviathan, however, had moved about 20 feet, but she was yet deep in her sandy bed. At the ebb of tide, Her Majesty's ships' respective crews were again required; and their exertions were renewed, as well in keeping down the water in the *Great Britain* by continual pumping, as in repairing and replacing the various apparatus for lifting the mighty prisoner.

"On Thursday Her Majesty's ship *Birkenhead* steamed quietly into her position, as it had been previously occupied, and carefully marked by buoys, having let go both bower anchors and veered to 100 fathoms upon each cable. The hawsers, 400 fathoms, laid down on the former trial, were taken in through the stern horse holes, and on this occasion they were passed over the large paddle-box boats, each capable of containing 140 men, lashed together and placed close to the screw of the *Great Britain*, to which they (the hawsers) were fastened. A fulcrum was so provided for the lever which the hawsers would thus form for lifting the massive burden they were designed to move, without diminishing the force of the tremendous strain to be employed in dragging it from its stronghold. The signal was given—the bars of the capstans were ready manned, and they began to heave, but they heaved in vain. When the *Birkenhead* took up her position, the water was smooth as a millpond, the sun smiling upon the operation, although the light clouds upon the caps of the Morne mountain indicated change of weather; symptoms of a breeze from the south, and with so much reason, to be dreaded in this dreary bay, "moved upon the face of the waters" The rising tide lifted the lighters with their logs of wood up to the outriggers, and the rest of the varied apparatus; but the *Great Britain*, overwhelming these with her monstrous weight, seemed to bid defiance to the means devised by human skill alone, although applied with stead'ast perseverance; some power superior was requisite. The camels, which were water-tight, were too large to be confined with the hawsers used, powerful though they were, and they bounced out of their strongholds with loud reports. Such as were leaky became waterlogged, and helped to obstruct the heave. The lighters seemed to slip from under their burden; the blocks flew out of their places, some of the outriggers and their shores yielded to the pressure, cracking with a frightful noise, and the great and powerful, but the steady strain upon the hawsers, by the purchases and capstans of the *Birkenhead*, was utterly futile. The iron mass could not be moved this day by these means, added to the lesser, although more numerous, purchases employed in the *Great Britain* itself. The signal, "She won't come off this tide," cast a damp of disappointment over every countenance, and of despair as to the result over the spirits of many deeply interested in the stirring event.

"The wind had, indeed, set in so fresh from the south, the very quarter fraught with peril to this shore, and of whose ravaging effects Captain Claxton had such dismal proofs, that the apparatus could not be replaced for a further trial on the next flood tide; and early the next morning, with the aid of such of the ships' companies as could be spared, and with care, as much as possible, to remedy the causes of failure in the former application of the lighters, &c., and the reduction of water in the hold, a renewed attempt was made on the part of Her Majesty's ship *Birkenhead* with the rising tide.

"The dreaded south wind had brought in an increase of tide. The officers and ship's company of the *Birkenhead* had made every arrangement for the renewed effort with *a more powerful and effectual heave, such as sailors seem alone qualified to make.* The powerful steamer was brought into her position again. The most watchful attention to the minutest points were observable in every officer of the *Birkenhead*, each one in his place, aiming at the success of all that was intrusted to him. Not a word transpired amongst the seamen. Signals were agreed upon. 'Heave'—'Heave with all your might'—'Avast heaving.'—'She won't come off'—and 'She moves.'

"On the first signal 'heave,' the hawsers, already on the stretch, were hove with a steady work-

' Heave with all your might,' was re-
by the increase of pace applied with all
of the men, each vying with his fellow
essel off. 'She moves' animated every
; each eye sparkled with the light of
warmed also every heart with an in-
mixture of gratitude and joy. The
ne in nicely. 'She is all your own, my
esponded to with cheers and fresh ex-
great steam ship obeyed the hempen
iron consort. The weight again seemed
o increase, as if the sand had come in
. the *Great Britain;* but it was not so.
captain, elated, as he well might be, with
gratification, had prudently cast his
ting the distance of the first movement
vessel to a point so near the low water
secure her floating with the next flood
ll so high and dry upon the sand as to
inspection of her bottom, and such re-
night diminish the influx of water, and
t the attempt to float her on the ocean.
iring tide exhibited the celebrated iron
right, high and dry, at once the asto-
nd the admiration of every beholder.
be seen the carpenters, and every one
or such work, with staves, and wedges
l oakum, and grease, and everything
used with probability of success, stop-
es, repairing breaches, and stanching
nich were terrific. At this juncture the
ers refused to work the pumps, which
ew labours from Her Majesty's crews.
atigable men were ready, though their
as exceedingly short. A light at the
announce the want of men, and in five
rk though it was when it appeared,
5 of the men who had been labouring
days and nights, from each of Her
ps. The motion of the *Great Britain*
y watched. A messenger came for
up hawsers and bring in the paddle-box
ne distance of nearly two miles. The
ently manned and pushed off. It was
e what was going forward. But soon
as spread—the wind which had lulled
from south to west, and now a gentle
north-west came off the shore, and
floating off the *Great Britain* from the
evidently approached the *Birkenhead,*
to create some apprehensions of her
of her. With her came the paddle-
d then the crew of the *Birkenhead* to
anchors. It was then made known
Claxton had been forced to slip his
t his hawsers, to escape being stranded
shallows of Dundrum Bay.
the men to heave the anchors, they
n from the pumps. Meantime it was
that the leaks being so great, and the
of water so rapid, the ship could
afloat. It was a moment of intense
labour of heaving the anchor seemed
sed tenfold, and every moment begot
eling that without help at the pumps
own. She appeared low in the water,
ne engineer betrayed such misgivings
hat both the *Birkenhead's* paddle-box
e lashed alongside for safety, in case
cy he seemed to dread. The anchors
g hawsers were soon attached, and
ied to the paddle-wheels of the *Birk-*
anxiety subsided. The return of men
reduced the water mark. Fresh hope
nd Strangford Bay, some two hours'
nised security to the heavy charge.
n to dawn, and we passed St. John's
hen 'Direct for Liverpool' was shout-
ster vessel. On reflection, however,
d by Captain Claxton, that men of
tle, exhausted as they had been by
ncessant labour of three nights and days, could not stand to the pumps, as it was needful, for the many hours ere the port of Liverpool could be made. The pilot provided was well acquainted with the narrow passage into Strangford Louth; but it was very narrow, and the current very strong. The *Great Britain* was very unmanageable. She would neither lead nor drive in any steady course; sometimes she seemed as if she would go right ahead and give the *Birkenhead* the go-by, had it been possible. Again, she crossed her towing path to try the starboard side, and then, as if sulky under her restraint, presented herself almost broadside to the draught. The pilot looked aghast, and said, 'The hawsers must be shortened; I cannot take her in if she yaws this way.' At this critical juncture, near the shore, and narrow entrance to the bay, a thick fog came on, so dense as to render the land invisible, and the very sight of the huge vessel, near as she was, to be indistinct. The *Birkenhead's* head was turned to the sea, and Belfast Harbour was determined upon. This was made with all the speed that could be made with such an unmanageable floating log. Off the Copelands, where the current is strong, the *Great Britain* seemed to set at nought her guide, broke the hawsers, and threatened great obstruction to every effort made in her behalf. Boats, however, were lowered down, and fresh hawsers being soon attached, we arrived without further accident in Belfast Lough. The *Birkenhead* cast anchor, loosing the hawsers from the *Great Britain*, which was towed into more shallow water by the *Scourge,* and finally was grounded on the mud, which helped to stop her leaks. On the following day, with fresh hands engaged by Captain Claxton to man the pumps, the *Great Britain* was taken in tow again by Her Majesty's ship *Birkenhead,* leaving the *Scourge* at anchor, and without any remarkable or untoward event but that of yawing from side to side, and now and then presenting almost her broadside, the great steamship floated gallantly and quietly to within about an hour and a half of the bar of the Liverpool port. The wind had now begun to blow fresh, the tide being at the same time very strong, when, in reply to the summons of a gun and signal, a pilot came on board the *Birkenhead.* The *Great Britain,* profiting by this slight alteration of the hawsers, began to be unmanageable. Striving with wind and tide for her liberty, she broke the starboard hawser close to her bow, which recoiled with violence upon the poop of the *Birkenhead.* The line prepared to lay out another hawser next snapped like packthread. The second hawser and the second line soon shared the same fate, and with terrific rapidity threatened desolation. The boats were soon lowered, and fresh hawsers were soon stretched out and fastened to the steam ship. Now, one of the large beams shipped in support of the substitute for a rudder to the *Great Britain,* gave way, and falling overboard caused much anxiety and delay. At length, with difficulty, through the swell that had arisen and the increasing wind, we proceeded, and with much apprehension lest through any further delay the present tide, together with all the labour, should be lost, the ship being wild and ungovernable. A second pilot-boat came alongside, and was eventually towed astern of the *Great Britain,* acting beautifully as a rudder, and facilitating thereby the entrance of the *Birkenhead,* with her charge, over the bar and through the channel into the Liverpool harbour.

"This service was performed after the rate of six and a half knots in the hour, including all stoppages, without loss of life or limb, and it may be said, without injury, save a few bruises sustained by a few individuals of the gallant and indefatigable crew, and the *Great Britain* was triumphantly brought into port in the presence of thousands, who rent the air with their joyful and congratulatory acclamations.

THE DUNDRUM BAY "TRIUMPH OF ENGINEERING TALENT."

Sir,—I quite agree with you, that the quantum of engineering talent brought to bear upon the rescue of the *Great Britain* steam-ship, was of the most meagre description. The whole affair seems to have been a complete series of blunders, from first to last, not by any means excepting the master blunder of running this fine vessel upon the Dundrum sands. Perhaps a few anterior blunders might be included,—such as building the monster in a situation from which she could only be rescued at great labour and expense.

At the very moment that Captain Claxton was sighing for a foot more water, every possible appliance was being employed to raise the vessel—that is to say, to raise the line of flotation still farther (!), so that Captain Claxton might have to sigh for two or three feet more water, instead of for only one foot.

Had the immense boxes, which may be seen, in the various "illustrations," dangling at the top of posts stuck in the sand, been employed as caissons, (in which capacity they would have had the effect of lowering the line of flotation several feet), Captain Claxton would have had water sufficient at the very time he was bewailing the want of it so bitterly.

The whole of the sand-box apparatus, and all the other multifarious and expensive appliances, could have had nothing to do in the removal of the vessel seaward. The local fixity of these tacklings must have rendered it necessary to cut all connection with the vessel before she "put to sea."

But, not to lengthen this communication, could not a quarter tide coffer-dam, say about 3 or 4 feet high, formed round the vessel, and pumped or bailed out every tide, have afforded sufficient time to repair the bottom of the vessel? This being effected, and a channel cut in the sand, the rescue of the vessel would have been accomplished with little expense, and without any of that flourish of trumpets which accompanied it.

I am, Sir, yours, &c.,

Δ.

VELOCITY OF THE ELECTRIC CURRENT.

Sir,—I have long had an idea that the velocity of the electric current might be measured by actual experime not having the opportunity mys leave to introduce the subject i columns, hoping that some of y ders will take up the experin publish their results through medium; as I am sure it is a teresting subject, and possibly of great importance in a scient of view. The wires of an elec graph seem to me to be peculiarl for this experiment.

If an electric discharge could to traverse a very long condu 200 or 300 miles), and both en circuit could be made to pass one and the same circular dis pared paper, or other material t take an impression of the disc it passes through it; (both en wires that transmit the current the disc, ought to be in the same then, by causing the disc to re great velocity, it seems probabl marks would be thrown asund angular distance, proportionat velocity of the revolving disc quently, the velocity of the elec rent would become known.

To avoid trespassing too mucl pages, I have only just hinte principle of the experiment, a intending to try it, will use suc as seem best adapted to his ow but, if any further explanation mation, that I can give upon th will be of any service, I shall b forward it at some future time.

I am, Sir, yours, &c.,

CHAS. CROS

Holme, Sept. 6, 1847.

ADCOCK'S SPRAY PUMP.

Sir,—In your 1248th numb is an article on the Spray Pum at Llanhithee, Monmouthshire. account there given, coupled Adcock's subsequent advertise the papers, may mislead persons unacquainted with the true state at Llanhithee, I beg to call your to the following memoranda, the spot, and in the presence o gentlemen connected with the interest of Monmouthshire:

To raise the water, Mr. Ad ploys air compressed by a blast of 48½ inches in diameter, an

fpiston—number of double strokes ıute, 20. The pillar of blast os- from 3 to 5 lbs. per inch; but, 4 lbs. as a mean pressure, it will, :ulation, give 54 horses as the .e power of the blast cylinder.

on of pit, 240 feet; depth of ›lown up in 8 minutes, 2 feet 6 supposed height to which the ı the pit would have risen in the me, 1 foot; making a total depth t 6 inches, which, multiplied by ion of the pit, gives 840 cubic water blown to a mean height of in 8 minutes, which, by calcula- barely equal to 4 horses' work.

; it appears that, instead of raising 'ith less power, Mr. Adcock, with ent spray pump, employs full ı *times* as much as would be re- with a common pump.

is is the result of six years expe- ng, I think that the sooner it is ned the better.

I am, Sir, yours, &c.,

CASSELL MORLAIS.

/r, Sept. 8, 1847.

PTION OF A NEW PROCESS FOR MA- .CTURING WHITE LEAD, OR CAR- .TE OF LEAD, INVENTED BY M. IAL.

'anslated in the Journal of the Franklin Institute.)

lifficulties which are known to exist ıanufacture of white lead by the pro- ıow in use, and the dangers to which kmen employed in it are exposed, ned me to undertake a series of ex- ıts, in order to discover a process imple and without danger to the :n.

l truly happy in being able to an- to the Academy that I have suc- in my attempts. *By a process ex- simple, in a very short time, without ıger*, I manufacture any quantity of ad that commerce may require, and luct will bear comparison with the :rfect that is made.

ıg the chemical and mechanical pro- hus far known, for the manufacture : lead, not one appeared to me to : the conditions necessary to obtain ›duct with economy and without nger to the workmen.

ent taken out in 1834 by Mr. Walker ›oints out a method, some parts of ndeed, seem to be new; but the de- ıs of this patent are so obscure, and at the same time so erroneous, that I have not thought it worth while to dwell on it.

The following is the description of the manner of proceeding, by which I arrived at a good result:—

A hexagonal or octagonal leaden cylinder is to be prepared, two metres in length, with a diameter of from thirty to forty centimetres. The lead should be from five to eight millimetres in thickness. This cylinder is to he enclosed in a frame made of rod-iron; to one end of which a crank is to be attached. It is to be placed on a stand, so as to receive with ease a rotary movement.

At the centre of the cylinder there is to be an opening or bung-hole through which the materials are to be introduced. At the end opposite the crank and in the axis of the cylinder, another opening is to be made, of from three to four centimetres in diameter, through which is to pass, without closing or stopping it up, an elastic tube fitted to a bellows. This tube must reach the bottom of the cylinder.

100 killogrammes of granulated lead and thirty litres of water are to be introduced into the cylinder; the bung-hole is to be closed, and the apparatus is ready to operate. In this state, if the lateral opening is closed, and the apparatus turned round at the rate of forty-five or fifty turns per minute, and if this motion is continued for five hours, about two-thirds of the lead will be found reduced to an impalpable powder and still retaining its metallic colour.

If the lateral opening remains open, then the lead so divided becomes oxidated, and the product taken out is a protoxide, or massicot, hydrated in part.

Lastly, if an elastic tube reaching to the bottom of the cylinder is fitted to the apparatus, the other end of which is attached to the bellows receiving air from a close chamber or enclosure in which there is burning charcoal; the finely divided lead coming in contact with the air and the carbonic acid blown into the apparatus by means of the bellows, is converted into oxide, and finally into carbonate of lead or white lead.

Acting on this principle, we manufactured a considerable quantity of a product, which was judged to be equal in quality to the best of that met with in commerce.

When the cylinder has been turned for a sufficient length of time, the bung is to be opened, and the liquid contained suffered to run out; a quantity of water equal to that first introduced, is put in, the cylinder is to be turned for five minutes, this second portion of liquid is to be run off, then the apparatus may be immediately re-charged for a second operation, introducing, however, only seventy-five killogrammes of lead, inas-

much as there remain twenty-five to thirty killogrammes not finely divided.

In order to facilitate, and hasten the operation, we have made use of two different processes. The first consists in pouring into the water, at the moment of charging the apparatus, 500 grammes of nitric acid. The second in substituting for the acid one killogramme of nitrate of lead.

It is, however, to be remarked, that during the operation a little nitrous acid is disengaged, and that when the operation is completed, scarcely any is to be found in the mixture that remains. I have observed that the acid or the salt of lead is decomposed. A sub-hyponitrite is doubtedless formed, which is afterwards decomposed by the carbonic acid.

The liquid product, withdrawn from the cylinder, is poured into a vessel containing eight or ten times the proportion of water made use of in the operation. This mixture, violently agitated, becomes considerably whiter, in proportion to the blue tint of the product taken out of the cylinder, which is occasioned by a quantity of lead, finely divided, but not yet oxidated; or yellowish, if formed of oxide not carbonated.

It is to be observed, that after two days washing, the whole of the product is of the most dazzling whiteness. However, I would here observe, that having dried immediately some white-lead which still contained about one-eighth of its weight of divided and non-oxidated lead, at the end of two months the entire mass had a homogeneous tint.

As in this operation some portions of granulated, and others of imperfectly divided lead, escape from the apparatus, it is necessary to let them deposit in vessels having openings at different heights. In the first place the clear water which floats above the deposit is drawn off, then by an opening somewhat lower down, the pasty deposit, which rests on the imperfectly divided particles of lead.

The pasty mass is thrown on filters of closely woven cloth, which have been previously fixed on frames. Here a large quantity of water drains off and leaves a plastic residuum. In this state, the filters are taken down, the ends of the cloth are folded over, and the whole is subjected to a violent pressure.

When this pressure has removed the greatest quantity of water possible, the packets are taken out, the cloths are taken off, the mass is divided into pieces of the desired form, and they are then placed in a hot air stove.

As may be seen, the theory of this operation is as simple as its manipulation. In adopting this system of manufacture, we have *simplification of labour, a bet duct, saving of manual labour, chance of loss.*

Until the present period, our turers, followers of blind routine, the form which the Hollanders gave to this article; but now, o men, our foremen are too well inf pay any attention to the particular shape that may be given to a produ when they learn that the adoptior new form or shape has for its pri ject the preservation of the health a many thousands of fathers of fami annually perish in consequence of results of the present mode of man they will doubtless applaud the int my publication, and will hasten to white lead in a new form.

To sum up the whole, my proce nufacture consists :—

1st. In granulating the lead.

2nd. In reducing it into indefi particles by friction on itself in a l linder.

3rd. In facilitating the oxidati lead so divided by the introducti mospheric air into the apparatus.

4th. In *carbonating* immedia oxide of lead by making use of charged with carbonic acid.

5th. In hastening the oxidatio lead, by introducing into the app tric acid, or the nitrate of lead.

6th. In washing the product ob this process.

7th. In hastening its desiccation jecting the result to the greatest pressure.

8th. In dividing by square p pressed mass.

9th. In drying in a hot-air divided product.

On the 24th of December, 183 and the closet of an apartment still by M. Mequignon, Jr., rue de Augustus, No. 9, were painted Coulon with white lead manufa me by this process; this paint, years, is as beautiful as when it applied.

The publication now made is e the benefit of the workmen. T facturers will hasten to adopt i think, moreover, that taking into lic health, the government ought im to interdict the method of making ting the lead into pots, which is cipal source of the painters', or le

Note.—1 metre = 39·37 inches metre = ·3937 do.; 1 millimetre = kilogramme = 15434 grains; 1 lit 1 quart.

MINGTON'S AERIAL BRIDGE.

ng the various sights and wonders ave attracted so many thousands to rey Zoological Gardens during the season, another has just been added, ids fair to become an object of much , not only to the sight-seers of the lis, but to the scientific man and tical machinist and engineer. The of this new wonder, which has been iately enough termed "The Magic Bridge," is Mr. Remington, a native ama, in the United States, who has y years devoted himself to the per- of various useful and curious me- l inventions; and one of his bridges, re are about to describe, is, we un- d, already in practical operation at gton. Across the sheet of water uns at the back of the orchestra, we, the master carpenter at the gar- as constructed, under the superin- e of Mr. Remington, a bridge, per- nique in its structure and appearance, light and fragile as the flying bridges by the Peruvian Indians across the of the Cordilleras. On either side rater-way a stout buttress of timber, ight feet in height, is erected, and on ttresses, stretching across the water- listance of 84 feet, are laid four laths gers, of common deal, tapering from louble that thickness to *one inch* in the centre of the water-way, he greatest strain and pressure might bly be expected. This constitutes lge previously to the footway being ; and the public will naturally be as lous as we were ourselves when they that these four slight-looking laths, nary brittle deal, glued together in places to obtain the required length, ich seem likely to snap with their ight, will support a very consider- den. The foot-tread is formed of deal, glued across the longitudinal s; there is no central support, or ing braces, either from above or and yet over this slight and aërial e we yesterday saw 13 or 14 stout rch at once, without fear or hesita- lthough a stranger, witnessing the ent for the first time, will naturally rous at seeing the frail support bend t like a half-tightened rope, as the vibrated along the bridge. Mr. ton assures us that three or four e number of persons who crossed it y, may venture upon it at once with t perfect safety, and that there is no l limit to the length of the bridge. magic" of the structure and the of the principle consist in the application of the longitudinal fibre of the wood, so that every portion is brought at once into play, and supports an equal share of the strain. The rapidity with which such a bridge can be constructed, and the comparative insignificance of the cost, are among the obvious advantages of the invention, and we have no doubt it will attract the attention and consideration of the scientific world. *Morning Herald.*

THE TURKISH STEAMER "VASSITER TIDJARET." — (PATH OF COMMERCE, OR PATH-FINDER.)

Our last advices from Constantinople announce the arrival at that port of the new steam-ship, the *Vassiter Tidjaret*, after having performed the voyage from Plymouth in the short space of 12 days, allowing for the time occupied by her detention at Gibraltar, Malta, and Smyrna.* This vessel was built expressly for the Turkish government by Messrs. F. and J. White, of Cowes, and is of the burden of nearly 1,000 tons, having a pair of Messrs. Maudslay's engines, of the collective power of 300 horses. Her arrival produced quite a sensation amongst the native and European population, who crowded from all parts to see her elegant form as she lay on the blue waters of the Golden Horn. The Sultan, who, since his accession to the throne, has been prominent in encouraging the extension of steam navigation in his empire, as one of the means most conducive to its welfare, and best calculated to promote the spirit of reform with which he is inspired, made an excursion on board the *Vassiter Tidjaret* in the sea of Marmora. After a run of a few hours, during which his Imperial Majesty examined minutely every part of the vessel, he expressed himself highly gratified with her performance, both as to speed and the easy working of her engines. Great praise is due to Mehmed Ali Pasha, the late High Admiral of the Turkish empire, who, with an intuitive sagacity and earnestness of purpose but seldom evinced by his predecessors, has been mainly instrumental in carrying out the liberal views of his sovereign; as during the two years of his administration of the naval affairs of the country, he toiled hard, and succeeded in eradicating abuses which were a barrier to all improvement, and left the arsenal better provided and better regulated than it had been for years before. Turning more particularly his attention to the steam navy, Mehmed Ali Pasha saw the imperative necessity of creating one more efficient to compete, in case of need, with the numerous fleet of steamers that, under a rival flag, plough the waters of

the Black Sea. During his administration two first-rate steam frigates, of 450 horses' power each, have been launched from the dockyard of Constantinople, and two others of the same power have since been placed on the stocks, and the engines ordered from England. It is to be hoped that the Turkish government will follow up the stimulus thus given to its steam navy, the importance of which must and ought to be fully appreciated.—*Times*.

THE ATMOSPHERIC RAILWAY SYSTEM.—ANOTHER DAMPER.

A meeting of the South Devon Railway Company was held on the 27th Aug. last. The report stated that no part of the line had yet been opened with the atmospheric apparatus, and that all that had been yet done, was to make some experiments between Exeter and Teignmouth. Mr. Brunel, the engineer of the line, stated in reply to a question from a shareholder, that it was, however, the intention of the directors to open the atmospheric line as early as possible to Teignmouth, and thence proceed to Totnes soon after, unless it should be found the line would be ready to Totnes shortly after they were ready to proceed to Teignmouth, in which case they would wait till they could open all the way to Totnes. Thereupon

Mr. HUDSON rose, and spoke to the following effect:—"He attended as representing an important Company, who had a large interest in the undertaking, and who were anxious for its success. He had himself been over the line; he had seen its capabilities, and he was quite convinced that, if it were managed judiciously, it would yield a fair dividend to the shareholders; but it was not a line which could afford to spend the shareholders' money in experimental undertakings. For one, he regretted that the Company should be involved in such experiments; still, as they had gone so far, it was due to the public, due to the inventor, that the system should be fairly tried; and he hoped that no time would now be lost in having the locomotives removed, and putting a power of *alleged* greater tractive force upon the rails. But, even supposing the new principle were of greater tractive power, still it would be necessary to see whether it could be rendered commercially useful. The expenses which had already been incurred upon this principle, amounted to about 10,000*l.* per mile; *and he feared the expense would ever be a vital objection to its adoption.* * * * He repeated, that the line, if fully worked, and the traffic were fully developed, would pay a fair dividend; but if they went into expenses of ordinary kind, then he must say upon it with great doubt; *and h there were no means equal to thei means of propelling trains.* H therefore, the board would *det resist any further outlay of capit direction* until they obtained a rep fully drawn up, both as to the ex the power of this new principle, a same time, comparing it in both with the means of traction now in

The suggestion with which Mr concluded, may be considered as a simply to an invitation to the ad the atmospheric system to answe can, Mr. Robert Stephenson's wo subject, published now more than ago, in which he demonstrated inferiority of the system (as far as developed), in every point of vie ordinary locomotive plan. It i which, though much carped at, yet been grappled with.

CALENDAR OF SPECIFICATIONS OF OF INVENTIONS. FROM THE WHEN THE PRACTICE OF EN COMMENCED TO THE PRESENT CONTINUED FROM P. 239.

[From the Reports of the Deputy-Kee Public Records (Sir Francis Palgr

THE CALENDAR.

[Of the two dates annexed to each first is the date of the patent, and the of the enrolment of the specification.]

Henry Ould, of Dartmouth, mat instrument maker: of a new im of the Hadley's quadrant and sext an apparatus or instrument to thereto at pleasure, whereby a tru effectual horizon can be artifically notwithstanding the real or natur should be prevented from being se interposition of land fogs or thic Cl. R., 32 Geo. 3,, p. 1, No. 13. Jan. 16, 32 Geo. 3, 1792.

James Peacock, of Finsbury-squ dlesex), architect: of "a new m the filtration of water and other fl plicable to heads of water of vari nitudes or extents for public servi voirs, or cisterns for private use, ling the ascent of the fluid throug tering medium instead of the comm by descent. Cl. R., 32 Geo. 3, p. 1 Dec. 23, 32 Geo. 3; Jan. 21, 179

Anthony George Eckhardt, of manufacturer: of an invention of or imprinting grounds or coats of tion or painting upon satin, sil linen, velvets, leather, or any kind

aper, for the receiving impressions ed copper plates in all sorts of nd for other purposes. Cl. R., p. 1, No. 2. Jan. 16, 32 Geo. 3; 16, 23 Geo. 3, 1792.

Spilsbury, in the parish of Saint stminster, chemist: of an inven- ertain medicine, called Spilsbury's atic Drops, which has proved an remedy for eradicating the most scorbutic disorders. Cl. R., 32 . 1, No. 1. Feb. 4, 32 Geo. 3; 32 Geo. 3, 1792.

'ate, of Oxford-street, ironmonger: vention of a machine with utensils ng on improved principles," con- different improvements in the mode g by and from an inclosed fire- rnace, the principal feature where- application of a boiler for raising cook with, but which may also be) other useful purposes, such as rooms. Cl. R., 32 Geo. 3, p. 2, March 2, 32 Geo. 3; March 31,

William Ward, of Hatton-garden, a method of changing the smoke arising from the combustion of l of substances into various useful according to the substances burnt. Geo. 3, p. 2, No. 1. March 15, ; April 13, 1792.

Primerose, of Lambeth, gardener: nethod of manufacturing all sorts rs into men and women's hats, ses, muffs, tippets, and shoes. 2 Geo. 3, p. 3, No. 12. May 3, ; May 7, 32 Geo. 3, 1792.

Manton, of Davies-street, (Mid- un maker: of a hammer on an principle for the locks of all kinds ns, and also an improved breech ds of double and single barrelled pistols. Cl. R., 32 Geo. 3, p. 4, April 18, now last, 32 Geo. 3; 1792.

ollinge, of Buxton-place, Lambeth, c and axle tree maker: of "an of and improvement in and upon and other wheel boxes and axle- e great excellence of which inven- sts in the superior principle of its parts, in conjunction with the pro- hich are made for a copious supply l a protection from the access of Cl. R., 32 Geo. 3, p. 4, No. 1. 32 Geo. 3; August 17, 32 Geo. 3,

avis, Tottenham-court-road, organ of "an entire new improvement eral musical instruments, called s and Harpsichords." The im- ts upon the pianoforte and harp- sichord consist in combining both these in- struments together, and in having them nearly in the same compass as one. The pianoforte has one row of keys for its own action, and the harpsichord has also one row of keys for its own action. The upper row of keys is for the pianoforte, and the under row of keys is for the harpsicord; so that when a person plays either of these rows, he plays either a complete pianoforte or a complete harpsichord. Cl. R., 32 Geo. 3, p. 5, No. 6. June 6, 23 Geo. 3; July 5, 1792.

Joseph Manton, of Davies-street, gun- maker: of "a trigger on an improved principle, for all kinds of double and sin- gle-barrelled guns and pistols, also an improved wadding for all kinds of guns and pistols." The utility of the triggers is in their being kept close to the sear of the lock by the spring, which pre- vents the trigger from shaking, and causes it to sound against the frames the same, let the gun be held in any direction whatsoever. The utility of the wadds is to keep the shot in the centre of the bores of guns, and thereby prevent the shot from rolling, strik- ing the sides, or injuring the bores thereof: they may be applied to all kinds of guns from the forty-two pounder to a musket; will have a very good effect in throwing shells, &c. Cl. R., 32 Geo. 3, p. 5, No. 2. July 5, instant, 32 Geo. 3; July 24, 32 Geo. 3, 1792.

James Rumsey, of Falcon-stairs (Surry), engineer: of "certain new methods of rais- ing water and other fluids, or applying their force to the purposes of milling, or giving advantageous motion or effect to various machines and engines," consisting of the following general principles, forms, and pro- perties, viz.: 1. In being capable of great variations in their forms and constructions, without thereby departing materially from their uniform principle, or receiving or com- municating their force in the manner of an inclined plane. 2. In being capable, as cir- cumstances may require, of acting either as agent or instrument in producing or giving advantageous motion to various kinds of machines. 3. In having the ability, when acted upon by heavy fluids, such as water, of communicating their force with advantage and simplicity to give power full motion to many kinds of machines. 4. In being capa- ble, when fixed upon boats or vessels when floating upon water, of giving them power- ful motion by the aid of horses, wind, or steam, or any other power applied thereto. 5. In constructing these machines in some cases, so that the water as it passes through the machines exerts both its action and re- action to give motion and force to the object

to be moved. 6. In being so formed as to work without inconvenience in backwater, or with uniform power and motion by the tide (or any other water), notwithstanding it may be continually varying its height. 7. In forming wheels for some objects, by fixing round their axis a spiral projection or fan of metal or wood in form of a screw, something similar to that of Archimede's Pump, against the spiral projection or screw, and in the direction of its axis (which may be elevated to any suitable degree), the water is brought to act; by which means it will give motion and force to the machine in proportion to the weight of the fluid expended, and the time and distance of its descent. 8. In some cases the construction of the machines for raising water or other fluids (by the application of any external force to give them a rotary motion), consists simply of a hollow axis of the height that the water is to be raised, which has at its bottom a pivot and valve (similar to those of the centrifugal pump): on the top of this hollow axis is placed a hollow wheel, out of which (when the machine is put in motion) the water issues from apertures at its opposite sides. This machine, with but little variation, besides being inverted, and causing the water from a fall to pass through it, becomes a powerful mill. Cl. R., 32 Geo. 3, p. 7, No. 13. July 24, 32 Geo. 3; Aug. 23, 32 Geo. 3, 1792.—(*To be continued.*)

NOTES AND NOTICES.

American War Steamers.—By a late Act of Congress, four war steamers are directed to be built; two first class, of 2,414 tons burden, and two second class, of 1,379 tons.

Dimensions of First Class.

Between perpendiculars	250 ft.	0 in.
Beam, extreme	45	0
Depth to gun-deck in hold	26	6
Second Class.		
Between perpendiculars	210	0
Beam, extreme	27	0
Depth to gun-deck in hold	23	0

The two first-class steamers, and one of the second class, to be propelled by side wheels; the fourth by a screw propeller.

One of the largest class is to be built at Gossport, and one at Philadelphia; one of the second class at New York, and one at Kittery, Maine.

A New Effect of the Magnetic Telegraph.—The various wires of telegraph beginning to intersect so many sections of our country are said to have a decided effect upon electricity. That eminent scientific man, Professor Olmstead, of Yale College, states, that as the storm comes up, and especially when over the wires, say 50 or 100 miles distant, the lightning is attracted by the wires;—which can be proved by any one remaining in the Telegraph-office for half an hour. About the time the storm is coming up, the wires are continually filled with electricity. "It is my opinion," he says, "that we shall never have very heavy thunder showers, or hear of lightning striking, so long as we have telegraph wires spread over the earth.—*American Paper.*—According to this we should long ago have ceased in such a city as London to have any experience of such a thing as a thunder storm; for what are all the telegraphic wires that have yet been erected, or that ever will be erected in any country in the world, to the prodigious quantity of iron rails and posts contained within any square mile of this vast aggregate of iron-fenced houses and streets? Professor Olmstead's ideas on this head are much at variance with those entertained by other men of science. Professor Leslie quite derides the idea of any non-conductor exerting an attractive influence at a distance of even fifty or a hundred *inches*.

LIST OF ENGLISH PATENTS GRANTED BETWEEN SEPT. 6, AND SEPT. 9, 1847.

John Mitchell Rose, of the firm of Rudall and Rose, Tavistock-street, Covent-garden, musical instrument makers, for certain improvements in flutes, clarionets, and other similar wind instruments. (Being a communication.) September 6; six months.

Henry Vint, of St. Mary's Lodge, Colchester, gent., for improvements in propelling ships and other vessels. September 6; six months.

John Burke Gustavus Ferryman, of Cheltenham, gent.; for certain improvements in handles to be applied to various articles for containing liquids, or other matters liable to be spilt. September 6; six months.

James Leadbetter, of Over Darwin, Lancaster, brazier, and William Pierce of the same place, mechanic, for certain improvements in machinery, or apparatus, for raising water and other fluids. September 6; six months.

Thomas Marsden, of Salford, Lancaster, for improvements in machinery for dressing or combing wool, flax, and other fibrous substances. September 6; six months.

Joseph Clinton Robertson, of 166, Fleet-street, London, C. E., for certain improvements in the manufacture of metals from their ores. September 9; six months.

James Sims, of Redruth, Cornwall, civil engineer, for certain improvements in steam engines. September 9; six months.

William Brockedon, of Devonshire-street, Queen's-square, Middlesex, gent., for improvements in heating rooms or apartments. September 9; six months.

Connor William O'Leary, of Tralee, Kerry, Ireland, for certain improvements in the methods of producing power for the discharge of weapons and missiles, and other purposes. September 9; six months.

Thomas Battye, of Woburn-place, Middlesex, gentleman, for an improved mode of retaining the waist of the human body in a desirable form, without producing the inconvenience resulting from too tight lacing of stays or corsets, or buckling of belts, waistbands, or girdles. September 9; six months.

Clemence Augustus Kurtz, of Manchester, manufacturing chemist, for certain improvements in the mode of preparing and using indigo in the dyeing and printing of woollen, cotton, and other fabrics. September 9; six months.

William Gibbons, of Corbyn's Hall, Worcester, for certain improvements in trussing beams and girders. September 9; six months.

John Blyth and Alfred Blyth, of Saint Arms, Limehouse, Middlesex, and John McCulloch, of Masemore Cottages, Old Kent Road, Surrey, for certain improvements in apparatus for distilling and rectifying. September 9; six months.

Frederick Steiner, of Hyndburn Cottage, near Accrington, Lancaster, for improvements in the manufacture of sugar. (Being a communication.) September 9; six months.

James Pitt, of Cheyne-walk, Chelsea, gentleman, for improvements in apparatus for holding down trousers. September 9; six months.

LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED UNDER 6 AND 7 VIC. CAP. 65.

Date of Registration.	No. in the Register.	Proprietors' Names.	Address.	Subject of Design.
Sep. 3	1185	Smith and English......	Princes-street, Haymarket.......	Spanner, or wrench.
,,	1186	Richard Farrar	25, Great Russell-street, Covent-garden	Office invoice, letter, and leaf-binder.
4	1187	John Baldwin Wheeler and John Lee Ablett..................	Poultry, London	Solatium stocking, or stock.
6	1188	Thomas Shutt Stock ...	Birmingham............................	Garden, or fire-engine.
,,	1189	William Staite.........	Radford Semele, near Leamington	Surface, or skim plough.
7	1190	Joseph Fenn	105, Newgate-street.................	Eccentric lever brace.

CONTENTS OF THIS NUM

NOTICE TO CORRESPOND

We are waiting the receipt of some which Mr. Craddock has kindly promi us, before concluding the series of a steam-engine improvements.

Communications received from C. C. *J. Ainsworth.—V.*

LONDON: Edited, Printed, and Joseph Clinton Robertson, of No street, in the City of London.—Sol W. Galignani, Rue Vivienne, Paris; Co., Dublin; W. C. Campbell and Co.

Mechanics' Magazine,

EUM, REGISTER, JOURNAL, AND GAZETTE.

258.] SATURDAY, SEPTEMBER 18. [Price 3*d*.

Edited by J. C. Robertson, 166 Fleet-street.

.. CRADDOCK'S PARALLEL DOUBLE-CYLINDER LOCOMOTIVE.

Fig. 1.

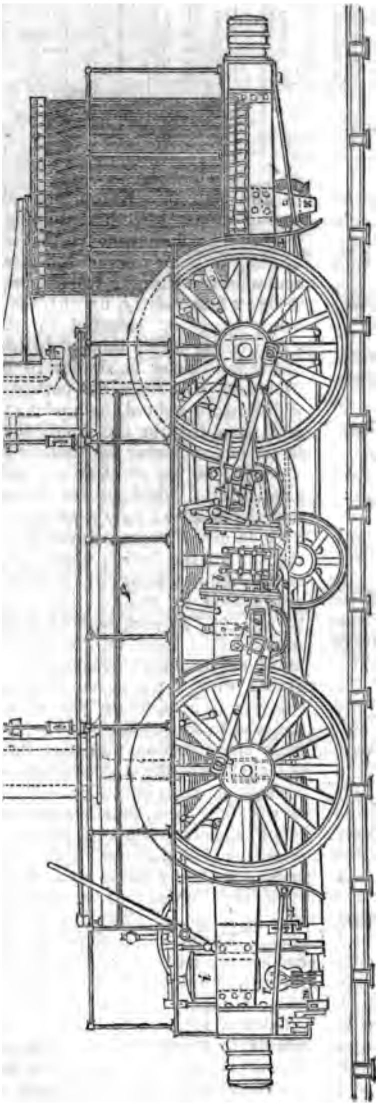
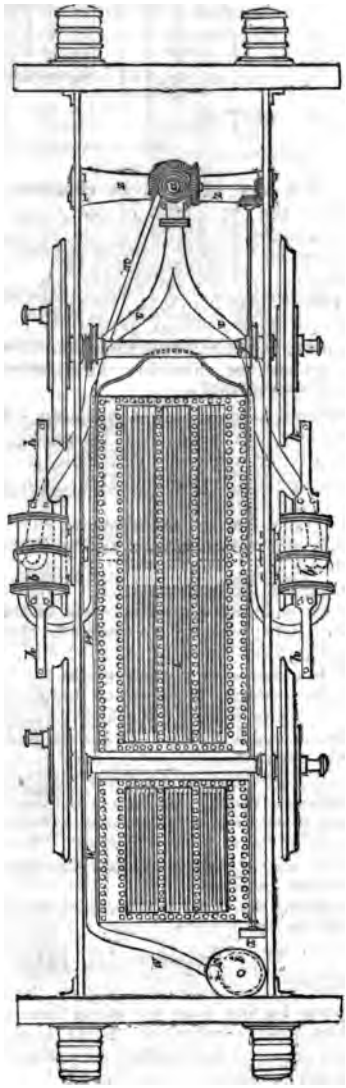


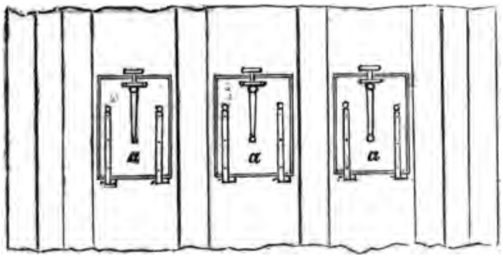
Fig. 2.



MR. CRADDOCK'S PARALLEL DOUBLE-CYLINDER LOCOMOTIVE.

(In continuation from page 125.)

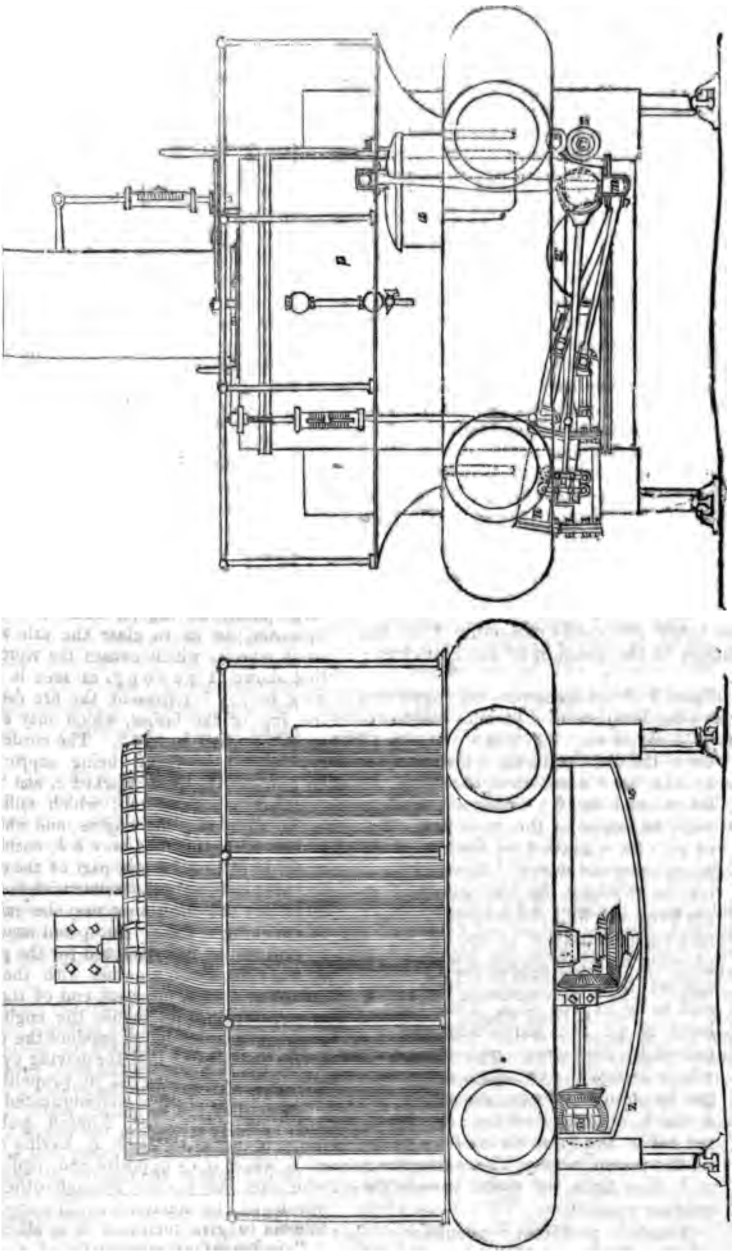
Fig. 7.



We now proceed, in conclusion, to show the application of Mr. Craddock's steam-engine improvements to railway purposes. Mr. Craddock describes two double-cylinder locomotives constructed according to his views—one in which the cylinders are placed parallel to one another, as usual; and the other in which they are set angularly, as described in the first of this series of notices. It may suffice to give his description of the former, as the peculiarities belonging to the latter are easily deducible from the change in the position of the cylinders:

Figure 1 of the accompanying engravings is a side elevation of a parallel double cylinder locomotive. Fig. 2 is a plan; fig. 3 a view of the front end; fig. 4 a view of the back end; fig. 5 a section right across the cylinders; and fig. 6 a sectional elevation through the centre of the condenser. Fig. 7 is a plan of a portion of the top of the boiler, showing the means of feeding it.

P is the boiler; *a* the high-pressure cylinder, and *b* the low; *h h h h* the guides; *e* the high-pressure piston, and *f* the low; *c* the connecting rod from the high-pressure cylinder, which takes hold of the hind driving wheel; and *d* the connecting rod taking hold of the front driving wheel. The valve here used is the same as that described in a former number (p. 170). The motion for working the valves in this engine is obtained in the usual manner, from the eccentrics *j* upon the front axle. *v v* are the exhaust pipes leading from the low-pressure cylinders to the condenser. *u u* are the steam pipes leading from the steam dome to the high-pressure cylinders. These steam pipes are conveyed down within the casing of the boiler, as shown in the plan fig. 1, and at *l* in the elevation fig. 5. The parts, marked *i* in the plan fig. 1, represent having ranges of tubes runni them. The flue space is that by the two outer rows of tubes, communicate with the two chim in fig. 2 (see also *j j*, fig. 5), th being somewhat enlarged to steam chests within them. In p action this boiler is similar to described (p. 124). The part c which stands behind the hinder rate from that in the front, t larger boiler having its under s upwards, so as to clear the s small wheels, which causes the tion shown at *g g g g g g*, as see *a a a* in fig. 7 represent the fi the top of the boiler, which n seen in section in fig. 5. The c represented in front, being s bottom by the part marked *z*, rounded by a hand rail, which tends all round the engine, an gether with the foot way *k k*, engineer to pass to any part of and also to supply the boiler wit meet any objection that may b the working of the air-pump and a small engine is introduced for of working them, together with pump, as seen at the back end o motive, which will enable the supply the boiler and to produce before starting, so that the drivi may be wholly employed in prc train. The motion is communic condenser from the friction through the small shaft *x*, hav mitre wheel at its opposite end, municates the motion through wheels to the condenser. The enabled to give such motion at the condenser, as may be foun through the friction pulley *x* a



x, which is acted on by the winch at the top of the spring balance (see fig. 4), thereby bringing the pulley *x* into contact with the pulley *q* (which last should have been represented on the small engine shaft); in which case it will be seen, that as more or less pressure is thrown on the pulleys, the condenser will be driven faster or slower, as may be required, whilst the spring balance will indicate the amount of power at any time required to drive it. *i* represents the air-pump; *m* the crank shaft of the small engine; *w* is the pipe which leads from the bottom of the condenser to the air-pump. The steam from the exhaust side of the low-pressure cylinder passes up the central pipe *f* into the part marked *b*. The manner in which the revolving joints of the condenser are constructed has been before described (p. 100).

In fig. 5 we have a different view of the boiler to anything before described, which shows the fire box extending up a little way above the letters *p*, whilst *j j* are the hot-air flues, *i i* the casing, which is supposed to have some non-conducting substance between it and the boiler; whilst the steam pipes *l l* are seen as passing out from between this casing and the boiler to the high-pressure cylinders *a a*; *b b* are the low-pressure cylinders; *y y* represent the valves.

The most striking peculiarity in this engine is, that it has *no blast;* and this, with many, will be considered at first sight as an insuperable objection to it—seeing that, according to Pambour, the quantity of steam generated in any given time without the blast, is but *one-fourth of that produced with the blast*. But let us see how Mr. Craddock, while candidly anticipating this objection, disposes of it. He shows, by calculations which seem accurate enough, that in a locomotive on the plan before described, there are five and a half times more heating surface than contained in one of Mr. Stephenson's narrow gauge engines; so that, against the four-fifths, which may be said to be lost for want of the blast, you have to set the four-fifths and a half gained by the increase of heating surface, which brings the two engines nearly on a par in point of steam generative power. Besides, in getting rid of the blast, we get rid at the same time of its re-action on the piston, and of the excessive heat and destruction of metal invariably attendant upon it.

Another prominent peculiarity, but which needs no set-off like the preceding, is, that it is an engine which req[illegible] water tender. The same wate[illegible] used over and over again, and b[illegible] gallons per day being required t[illegible] up for leakage, there is no need [illegible] rying fresh supplies along with [illegible] gine.

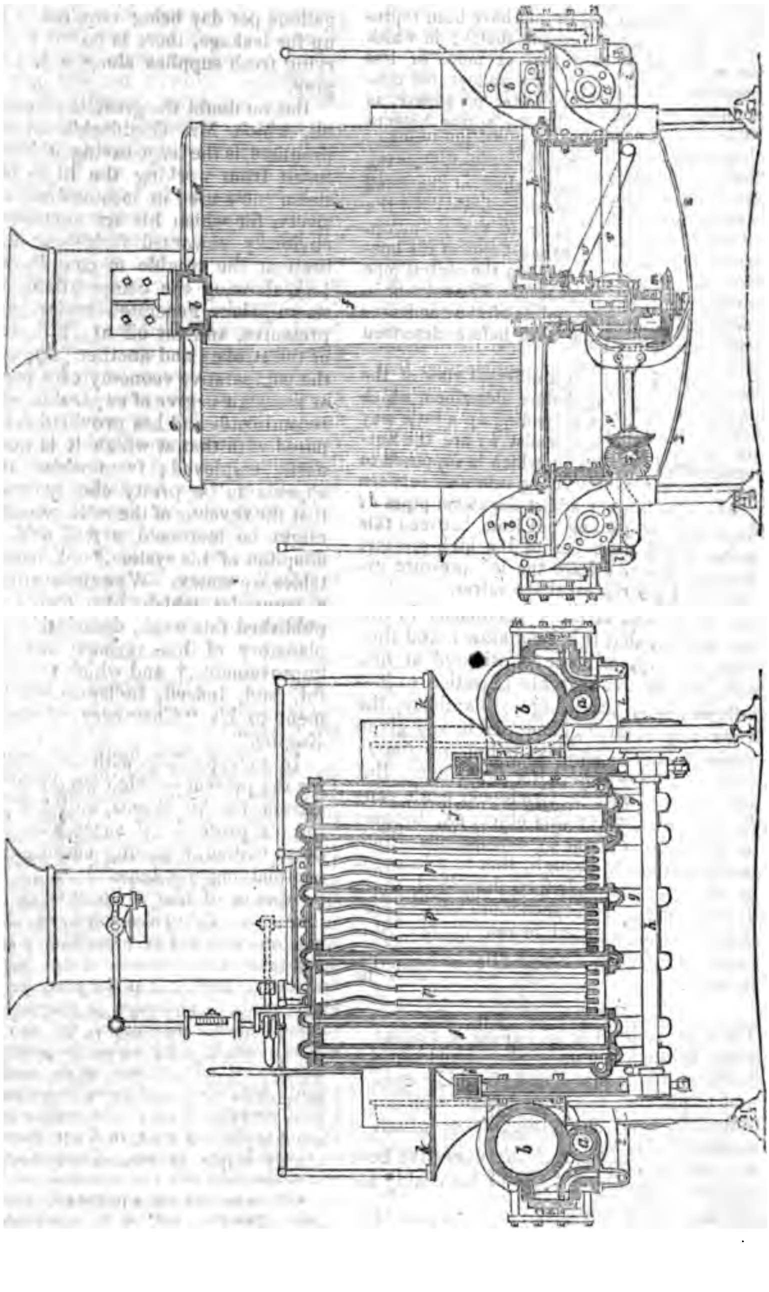
But no doubt the greatest adva[illegible] all, which Mr. Craddock's loc[illegible] promises, is the large saving whic[illegible] result from working the high-[illegible] steam (now used in locomotives) [illegible] sively, for which his arrangeme[illegible] obviously unwonted facilities. [illegible] been at the trouble to compile [illegible] (A), showing the comparative [illegible] steam when generated under [illegible] pressures, and cut off at differe[illegible] of the stroke; and another (B), [illegible] the comparative economy of usin[illegible] at the high degree of expansion w[illegible] recommends and has provided fo[illegible] pared with that at which it is n[illegible] narily employed; from which [illegible] appears to be pretty clearly m[illegible] that the revenue of the railway co[illegible] might be increased *a full fifth* [illegible] adoption of his system.* Both [illegible] tables we annex. We extract the [illegible] a pamphlet which Mr. Cradd[illegible] published this week, descriptive [illegible] planatory of his various steam [illegible] improvements,† and which form [illegible] ful, and, indeed, indispensable [illegible] ment to his "Chemistry of the [illegible] Engine."

In now parting with Mr. C[illegible] for the present—which we do wi[illegible] esteem for his talents, and best [illegible] for his professional success—we [illegible] do so without a passing comment [illegible] complaining yet hopeful tone in [illegible] he speaks of his public receptio[illegible] inventor. Take, for example, th[illegible] clusion to his last pamphlet con[illegible] the tables:

"I am well aware that the results [illegible] out in these tables are startling, and [illegible] many will be disposed to doubt; [illegible] though this may be the case, yet if t[illegible] weigh with candour the evidence add[illegible] support of the invention, which now [illegible] is as fairly set before the public as e[illegible] anything of the kind, they will find i[illegible] ciently ample to remove all doub[illegible]

* These are the tables (called by an err[illegible] press "letters") referred to in our last "Notices to Correspondents."

† Simpkin, Marshall, and Co., 8vo., pp. [illegible]



their minds, if they possess the requisite knowledge of the subject, and that freedom from envy or adverse interests which will permit them to form an impartial opinion. But where the mind is prepossessed with these detracting influences, the history of the world affords too much evidence, that in proportion to the value of anything, and the abundance of proof that it possessed such value, so has been the determination of men thus influenced to obstruct it, and who have thus, to the utmost of their power, opposed the laws of providence, and deprived the mass of mankind for years of some of the richest blessings, in addition to the injustice which they have perpetrated against individuals. From such men I expect no encouragement, but from the most intelligent engineers, from scientific men, and from the multitude of my fellow beings, I still entertain the most encouraging anticipation that they will aid me, at least by their countenance, in accomplishing that which, from first to last, I have desired to accomplish, viz., a great and lasting good, in which all mankind may participate."

Mr. Craddock has not had his inventions as instantly and as fairly appreciated as he would like, and as they deserve. He but shares in this, however, the common fate of inventors—nay, the common fate of all who seek to innovate on existing, and perhaps long-established, practices and usages. He must, like others, bide his time. For as surely as light follows the rising of the sun, so surely must any really new light in science attain, sooner or later, to meridian splendour. People of the inventive class are prone to talk of the "revolutions" they are daily and hourly achieving; but in truth, "revolutions" — actual and positive "revolutions"—are quite as rare in the philosophical as in the political world. What they call revolutions are almost always but steps of a mighty progress, in which it is our fate to behold for ever—

"Alps on Alps arise."

There is a climbing as well as a resting stage in such things. Mr. Craddock is in the climbing stage, and should be content to put up good-humouredly with the difficulties and discouragements which necessarily belong to it. He possesses, we observe, aids and appliances which not many other climbers up the hill enjoy, and need but make a good use of them to be soon left without any cause for complaint. He dates his pamphlets from a large steam-engine ma in Birmingham, where he stat "constructed several engines patented plans, and where th be seen" by any one who will trouble to inspect them and capabilities. Now if he will one step more (up the hill)— can have no difficulty in takii the circumstances in which he i we will answer for it, that in least, as regards the applicati improvements to railway pur will not be long without reapir reward. He has but to put on his plan *on the rail*—whi the Liverpool and Mancheste North Western Company, wi give him an opportunity of d instance these companies fron knowledge of the great facil are in the custom of renderi ventors, often at considerable e themselves)—and if it accom one-half of what his tables w us to anticipate, its general a certain. Neither "envy" verse interests" could avail anything, against the pounds, and pence argument which suc would supply.

The table A, which follows, is two principles, which are thus en Mr. Craddock:

"The first of these leading pr that water charged with heat b elastic gas or steam. Secondly given weight of steam (a pour stance) contains at all pressure quantity of heat; so that, by steam under high pressure, we c more fuel per pound of steam t at low pressures. To convey to t mind, who may not have previou the subject, the importance of thi necessary to state, that as the pres which steam is generated is inc volume becomes diminished, for weight; but, by diminishing the resistance, it will expand to an extent: and, what is of equal im a clear understanding of the ma as long as no heat escapes from no condensation ensues. Hence lute mechanical effect of a pound is, when used without expansion at all pressures; for, as it dim pressure, it compensates by its volume."

EXAMPLES.	Expansion	... the steam, or exclusive of that due to it in common with the other gases by increase of sensible heat.	to the dilation of the steam by the increase of sensible heat.	feet, showing the average pressure throughout the stroke.	quantity of coal in lbs. per 1000-horse power; or, by cutting off 3 whole numbers to the right hand, the quantity in lbs. and decimal parts of a lb. per horse-power per hour.	quantity of coals in tons required by marine engines equal to 1000-horse power for 336 hours, or the time supposed to be occupied for the voyage between Liverpool and New York.	effected by the saving of coal in the generating of the steam in the boiler, shown as before (column 5) in lbs. of coal per 1000-horse power.	nomy produced in the generating of steam in the boiler, represented in tons per voyage, as shown in column 6.
No. 1. On entering the cylinder at 200 lbs. and cut off at $\frac{1}{64}$......	200	900	435	23.98	1074	161	767	115
No. 2. Ditto at 100 lbs. and cut off at $\frac{2}{64}$......	200	750	310	19.68	1308	196	934	140
No. 3. Ditto at 50 lbs. and cut off at $\frac{4}{64}$...... This represents the Cornish system	200	600	215	15.85	1625	243	1160	174
No. 4. Ditto at 20 lbs. and cut off at $\frac{10}{64}$......	200	382	112	10-84	2376	356	1640	254
No. 5. Ditto at 15 lbs. and cut off at $\frac{18}{64}$ and $\frac{1}{3}$ of $\frac{1}{64}$......	200	328	88	926.	2677	401	1912	286
No. 6. Ditto at 20 lbs. and cut off at $\frac{1}{8}$...... This represents the present marine practice.	200	128	76	6.31	4082	612	2916	437
No. 7. Ditto at 50 lbs. and cut off at $\frac{4}{8}$...... But working against the atmosphere, as in the common non-condensing engine.	200	87	102	6.07	4243	636	3031	454
No. 8. Ditto at 85 lbs. and cut off at $\frac{3}{4}$...... And working against the atmosphere and the resistance of the blast-pipe, as in the locomotive. In this example the steam is supposed to quit the cylinder at 35 lbs. pressure above the atmosphere, or 50 lbs. absolute pressure.	200	62	108	5.78	4456	666	3180	477
No. 9. Ditto at 20 lbs...... Without expansion.	200	—	36	3.68	7000	1050	5000	750

TABLE (B).

Shows the relative economy in the Locomotive Engine, as brought out by a comparis

Examples Nos. 1 *and* 2, *Table* A, *when compared with that of No.* 8 *in Table A*

Note.—The saving as set forth in column 2 is obtained by taking the revenue or traffic account, as i by the statement of accounts given of the Manchester, Sheffield, and Lincolnshire Railway, for th year ending June 30, 1847, in which account the traffic is set down as 51,486*l.*; the cost of coke fo traffic being 2,890*l.* If, therefore, we double these amounts, so as to make them answer for the ye have for revenue or traffic account, 102,972*l.*, and as cost of coke for the year 5,780*l.* In Tuck's Ra Shareholders' Manual, page 114, is given the aggregate amount of revenue on traffic proceeds for tl ways open in 1845, as 6,124,800*l.* per annum. By dividing this sum by 102,972*l.*, being that of the re of the Manchester, Sheffield, and Lincolnshire Railway, we obtain an approximate cost of coke f whole of the lines there given.

EXAMPLES.	Col. 1. Saving effected on £346,800 being the annual cost of coke on the railways open in 1845, as brought out according to the note at the head of the Table.	2. Saving per cent on the cost of coke.	3. Saving cent. on whole l motive penses.
No. 1 shows the relative cost of coke, as brought out by a comparison of No. 8 in Table A with No. 1 in Table A.	£286,487	82½	29
No. 2 ditto that brought out by a comparison of No. 8, Table A, with that of No. 2 in Table A.	£273,790	79	27

Supposing the available balance to be such as to afford a dividend of 5 per cent, up outlay equal to that of the London and North Western line, such available dividend be increased by the saving in coke alone 15 per cent, and would enable the directors to the shareholders an additional 15*s.* on each 5*l.* If to this was added the increased eco which would be attendant on the system set forth in Examples 1 and 2, the saving exceed 1 per cent., or would increase the value of such railway property, or, what i same thing, the revenue arising therefrom, *one-fifth.*

THE "TIMES" AND STEAM PRINTING.

"The invention of printing is the greatest event in history. It was the mother of all modern revolutions. It was a complete change in the mode of human expression; it was a human thought throwing off one form and assuming another. It was the complete and definitive renewal of its skin by that symbolical serpent, which, since the time of Adam, has represented intelligence!" Thus writes Victor Hugo.

When the old-fashioned "double-pull" platen press, manufactured of wood, with a metal screw, was partially superseded by the introduction of another, manufactured altogether of iron, from the plans of the late Lord Stanhope, it was thought that the progress of invention (in this direction) must stop; but subsequent experience has shown tl this, as in other branches of the art improvement but prepares the way f other. No sooner were presses ma iron, than the idea occurred of wo them by steam; and the first to we the new and happy thought wa proprietor of a journal which sto instant need of some such powerful liary, to enable him to keep pace a circulation unexampled in the h of the press, and who, without it, most assuredly never have been al attain to that prodigious influence for many years past has at once aston and awed the world. Kœnig, the inge inventor of the steam press, found i proprietor of the *Times* his natur best possible patron. With the l

e late Mr. Walter, he produced a of somewhat gigantic size, but less possessing a completeness of nd purpose which cast all other printing presses into the shade. here were who, looking only to te interests, were in alarm, lest duction of steam printing might trade; and when it was found were actually discharged—that our was superseded by steam— ntors of the machine, and those couraged them, were actually s enemies of the working classes. rk the result! A generation of ounting to some seven or eight individuals, who were called en," were partially, and only , thrown out of employment; for these people were able to "take t case," and earn a decent living ay; so that, after all, the *imme-* ury was not so great as might have ected; while, on the other hand, n press has given occupation to ousands who, but for its intro- would have been standing d who ought, one and all, to e memory of Mr. Walter for the inventor to work out his d perfect his great and glorious ing. Consequent upon the great y, the old inking-balls were soon e, to give way to the use of com- rollers. Then the first idea of printing was improved upon: s, instead of producing seven or ndred sheets of printed paper an re soon made to throw off almost y thousands. The *Times* still e with the genius of invention. lter patronized every mechanical ment connected with the press. hen his health was declining,— found that he must shortly pass "bourne whence no traveller " he was still as ardently as ched to the promotion of useful and was busy with a plan for g and trebling the number of ions, which the four cylinder ma- ere capable of producing. We a machine which is at this t in the course of erection in a apartment fitted up for the , adjoining the *Times* office, promises far to surpass every f the kind which has yet ap- The inventor is the well-known Mr. Applegath. It is a wondrous thing to look at in its entirety; but if examined part by part separately will be found to be, in truth, a very simple machine. Imagine a large upright cylinder, of some five or six feet diameter, revolving upon its own axle. On this the type is firmly fixed in iron frames. Each frame holds a page, or six columns of the *Times*, and the bed of this frame, which is an arc corresponding to the circumference of the large cylinder, is planed flat, or rather the parts on which the columns are placed, are planed flat, so that the arc described by the frame or "chase," is scarcely perceptible, or if perceptible, it offers no impediment to the perfect impression of the whole newspaper. This large cylinder may be said to perform a double duty. A portion of it has a vibratory motion, which serves to ensure an equal distribution of the ink; without such a contrivance, the type would soon become clogged, and the appearance of the printing would be anything but satisfactory. Around this huge cylinder there are eight others which revolve on their own axes at stated distances—attendant satellites, as it were, on the great cylinder which is revolving within; and as the form in its revolution passes each of these impression cylinders (as they may be termed), a sheet of printed paper is produced. Then there are minor satellites which revolve close to the impression cylinders, and apply the ink to the type after it has been taken from the duct, and distributed. It must be understood that the cylinders and rollers are all upright. It is calculated that the large cylinder will make thirty revolutions in a minute; and as each revolution will produce eight papers, the machine in one hour will throw off not less than *fourteen thousand four hundred sheets!* But supposing that, at the rate of thirty revolutions a minute, the centrifugal force should have a tendency to throw off the forms of types, a thing by no means unlikely, the rate of speed can be easily reduced so as to produce only ten or eight thousand sheets an hour. Even at these diminished rates of production the advantage gained will be immense; for the present rapid machines will not print more than five thousand sheets an hour, and some not more than four thousand. The manner of feeding the machine is re-

markable. To each impression cylinder there is an extensive tape webbing. A lad draws, by means of a "key," the sheet to a certain spot, indicated by a mark; at this moment it is lying horizontally, but by means of friction rollers it is drawn into the webbing and conveyed to such a distance that the sheet stands confined by the tapes in a perfectly upright position: now it comes to a dead stand, and when in the position stated, it is gripped, and then received by other tapes, which convey it round the roller where, after the operation of printing is performed, it is received by a boy.

That this machine may be made to produce printing equal to what we witness now-a-days (we speak of newspaper printing) there cannot be a shadow of doubt; but that "fine work," or anything equal to it, will be the result of the invention, there is not much probability. Altogether, however, Mr. Applegath's machine is as extraordinary as it is novel and simple; and must tend to extend his fame as an inventor and engineer throughout the world.

MR. GEORGE STEPHENSON'S NO-PATENT RAILWAY BREAK.

We extract the following notice from the last number of the *Railway Record:*

"At the late quarterly meeting of the Institute of Mechanical Engineers, held in the theatre of the Philosophical Institute, Birmingham, J. G. M'Connell, Esq., of the London and North Western Railway Company, in the chair, the following communication was received from George Stephenson, Esq., President of the Institute, on a new self-acting break, a beautiful model of which accompanied the paper:

"'The various accidents on railways arising from concussions and collisions (and especially the late accident at Wolverton) have induced me to draw my attention to the construction of a self-acting break, which I have for several years had in view, a plan and model of which I have had made, and now lay before the Society, with my description of its action and effects. When a railway train is moving at the rate of from 40 to 60 miles an hour, the momentum is so great that it cannot be stopped in any reasonable distance by the breaks at present in use; or if an axle-tree break, or any accident happen to the engine, so as to prevent its progressing, the sudden shake causes the carriages to overrun each other, a[n] next the engine are almost certai[n] crushed. In an accident of this k[ind] ther the engine-driver, stoker, or g[uard] be prepared; and before there is any of them to put on the break a[t] in use, so as to be in the least deg[ree] tive, the collision or concussion h[as taken] place.

"'When the engine-driver shut[s] steam, or applies his break on th[e] the self-acting break is immediately to bear upon every wheel attached carriage in the train so powerfully, sary, as to bring every wheel into t[h] tion of a sledge. I think the trai[n] brought to a stand by this break tenth of the space in which it can b[e] breaks at present used.

"'My plan is as follows:—I couple of spiral springs to the lever break of every carriage, and also them with the buffers, and if the requires gentle breaking (which wil[l] be the case when a train approach tion), the engine-driver, by shutti[ng] portion of the steam, or applying t[he] gently, will have complete comm[and] the train, without any of those vic[ious] easy motions, which are very frequ[ent] excessively disagreeable to passeng[ers] as the guard is frequently compelled his break so powerfully as to m[ake] wheels slide on the rail, and cause derable amount of wear and tear on of the wheel, by which it becomes fl[at] and makes the carriages uneasy, an[d] a jumping motion on the rail.

"'Suppose a train of carriages m[oving at] the rate of from 30 to 40 miles an h[our] a signal is held out for the engine-[driver to] stop, the moment he shuts off the s[team the] whole of the breaks are brought int[o] application of sledging the wheel[s] will be more effectual than 50 men the common breaks, as the mischi[ef] quently done before the guard ca[n be ap]prized of the approach of danger.

"'It is frequently necessary for t[he train] to be backed into a siding. Whe[n] required, the train will first hav[e] stopped, and in one minute the who[le] breaks can be disengaged from the as is shown in the model, and when proceeds, they are again dropped i[n]

"'The plan altogether appears so that any ordinary mind can easil[y] stand the whole of it; and I think of putting the breaks on each carria[ge] not exceed more than from 5*l.* to 1[0]

"'Any effectual plan for increa[sing] safety of railway travelling is, in m[y] of such vital importance, that I pr[

ing my scheme open to the world, to taking out a patent for it; and it will be a source of great pleasure to me to know that it has been the means of saving even one human life from destruction, or that it has prevented one serious concussion.

"'GEORGE STEPHENSON.'"

It will surprise no one, who calls to mind how extensively and how incessantly Mr. George Stephenson has been practically occupied in carrying out the railway system ever since its commencement, and how little time, therefore, he can have had to read what others have published on the subject, or even addressed to him directly and personally, to find "the Pope of Railways," as he delights to hear himself called, so ignorant of the various remedies which have been from time to time proposed for the evil which he so humanely seeks to remedy. We could mention off hand (were it necessary) some half-a-dozen plans, at least, which have been proposed for acting simultaneously on the breaks of a railway train; but the idea is so old, and so familiar to most people, as to render special citation superfluous. Not knowing what others know, Mr. George Stephenson acts with indisputable generosity in not "taking out a patent" for his supposed invention; but, as matters really stand, he but gives to the public for nothing what (as far as the would-be donor is concerned) is exactly worth what it costs.

A NEW AND PRACTICAL METHOD ASCERTAINING THE VELOCITY OF PROJECTILES.

Sir,—It has struck me that the velocity of rockets or cannon-balls could be far more correctly and minutely ascertained by the aid of electricity than by the method now in use. The mode of effecting this desirable object I will endeavour to describe in as plain and in as few words as I possibly can. Let a long thin copper wire be conveyed and suspended upon dry sticks from the position of the ordnance or cannon to the distant point aimed at. At that point the electric circuit would be formed in the following manner: A small portion of the wire, having one end in connection with the earth, and the other terminating in a small cup of mercury, would be attached to the "*mark*," and a copper ball, having one end of the long conducting wire attached to it, would be placed in such a manner over the cup, that the least vibration caused by the projectile in striking the "*mark*," would make the brass ball to drop into the mercury, thereby forming the circuit. This formation of the circuit by the ball would be instantly indicated at the first or propelling position, by the movement of a small galvanometer introduced into the circuit; and the time elapsing between the act of firing the cannon and the movement of the needle of the galvanometer would represent the velocity at which the projectile traversed the given distance.

OWEN ROWLAND.

11, Heathcote-street, Mecklenburgh-square.

THE POETRY OF STEAM.

Every one knows that the poet laureat has unequivocally *pronounced* against railways. To William Wordsworth, not less than to Colonel Sibthorpe, the very name is fraught with unpleasant images, and redolent of utilitarian and Mammonish associations. "Is there no nook," says the Patriarch of Rydal Mount—

"Is there no nook of English ground secure
From rash assault? Schemes of retirement sown
In youth, and 'mid the busy world kept pure
As when their earliest flowers of hope were blown,
Must perish. How can they this blight endure?
And must he, too, his old delights disown,
Who scorns a false utilitarian lure,
'Mid his paternal fields at random thrown?
Baffle the threat, bright scene, from Orrest head,
Given to the pausing traveller's rapturous glance!
Plead for thy peace, thou beautiful romance
Of nature! And, if human hearts be dead,
Speak, passing winds; ye torrents, with pure, strong,
And constant voice, protest against the wrong."

Now, we do not profess to know how far ancient schemes of retirement may endure the blight of locomotive smoke, while we doubt not that poets and others, who scorn a false utilitarian lure, will find no music in the steam whistle or the fog signal. But we candidly confess our extreme surprise that a philosophic poet should call upon the winds and torrents to protest against the wrong inflicted by the great civilizer of modern times. We feel, indeed, confident that the torrents of Windermere, while with pure, strong, and constant voice, they make music to the listening ear of meditation, may not unprofanely be made to minister also to the requirements of the steam boiler. Thus, if we have less of the *vis divinior*, we conceive we shall find more

common sense in the following replication :

Scorn not the railway, Wordsworth! you have frown'd,
  Because the railway threatens Windermere;
But did you live in London, 'twould be found
  You would be glad to bring the blue lakes near;
To change, within an hour or two, the sound
  Of Fleet-street for those wanton wood-notes clear;
The crush and crash of cabriolets and crowds
For meditation of the mingling clouds.
For us, we love the railway as a sign
  And token of a world-embracing power,
Which shall in time all men and minds combine,
  And creeds and systems. Pray thou that this hour
May come, and quickly, and this faith prevail;
And scorn not, Wordsworth—scorn not thou the rail!

For even as thou hast called upon the critic to "scorn not the sonnet," with that key Shakspere unlocked l and Petrarch and Spencer, by that gave vent to their sorrows, Dante t casional relief from indigestion, an to his indignation; so do thou, gr of the past, teach thyself respect agent by which, as by a key inde merce will unlock her stores; b medium the nations will learn to c cate with and to understand one ambition, and war, and turbulence in subjection; colonization devel neglected treasures of the imperi mony; and knowledge, civilization, ligion cover the earth as the wate the sea.—*Railway Record.*

FENN'S ECCENTRIC LEVER BRACE.

[Registered under the Act for the Protection of Articles of Utility. Mr. Joseph Fenn, tool-manu of 105, Newgate-street, proprietor.

Fig. 1.

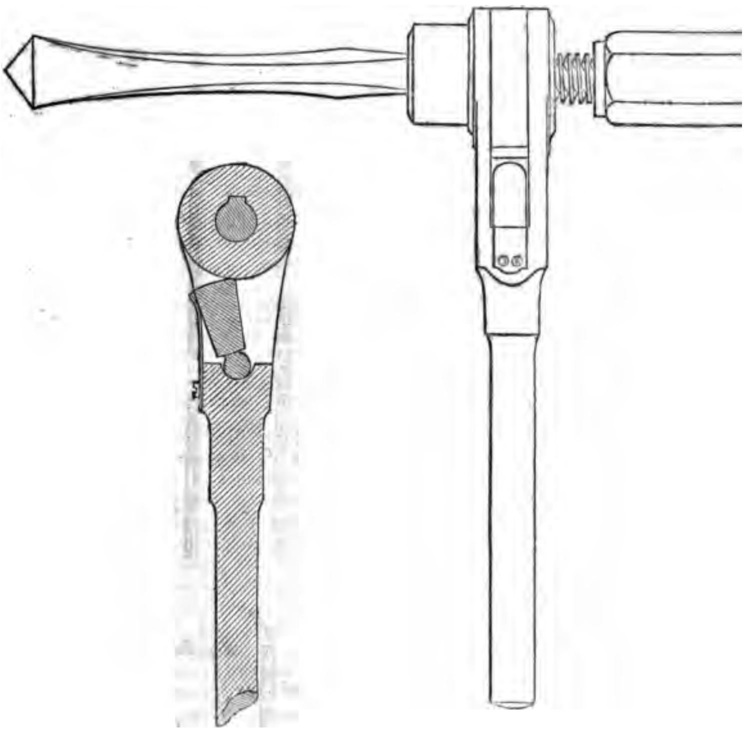
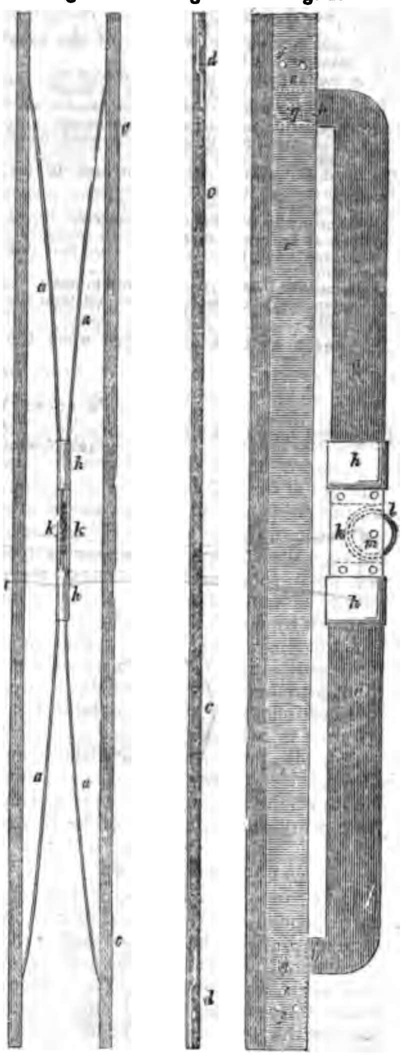


Fig. 2.

Mr. Fenn, to whom tool-making in all its branches is already much indebted, has this week registered a brace which is so cleverly constructed, that it n worked in almost any situation ho contracted. Fig. 1 is a side eleva

trument, and Fig. 2 a sectional the line *a b* of Fig. 1. A is the ck, B the screw, which is in one ith the drill-stock, and C the ut and top centre; D is a steel r wheel, which is fixed to the f the drill-stock by a slip feather ove, so that both must turn to- E is an eccentric tumbler, or hich is kept in its place by the F, and abuts at one end in a socket in the butt of the handle at the other against the wheel in such position that it allows lle to run free in one direction ie drill-stock, but when the s turned in an opposite direction, locks them, so that both must ether.

Fig. 2. Fig. 4. Fig. 1.



HAWKINS' PATENT CLIP.

dated March 10, 1847. Specification eptember 10, 1847.

ie who is acquainted with the genuity of our worthy friend, n Isaac Hawkins, and with the cal completeness of every thing mes from his hands, will deem than a matter of course that applied his mind to the improve- paper clips, he should devise best yet produced.

bject of the invention is stated to roduce an instrument to grasp, hold together, or file, a collection in a condition to be turned over eaves of a book, without the in- presenting any inconvenient ance to hinder two or more such ollections of papers from lying y together in a portfolio; the instrument forming a kind of y binding, and occupying only a ce along the back margin of the papers."

ventor effects this purpose by the esented in the accompaning en- ; fig. 1 being a flat view, as seen ng on a table; fig. 2, edge view, hen looking against the front at margin; fig. 3, end view; and the bars, or long jaws, *c*.

present two pair of springs, of other elastic metal.

jections extending sideways from mities of the springs, to act as ing jaws for grasping or clipping rs in two places, more or less om the top and bottom of the

ir of bars, or long jaws, attached

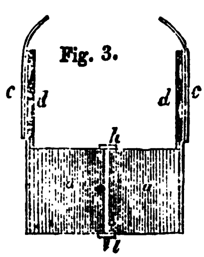


Fig. 3.

to the projections or short jaws *b*, for the purpose of grasping the back margin of the papers throughout its whole, or a greater part, of its length.

d, four forked plates rivetted to the long jaws *c*, to form recesses for the short jaws *b*, to act in and press the long jaws against the papers.

e, flat view of these forked plates, shown by the dotted lines at two places in fig. 1, and shown separately in fig. 2, which is an edge view.

f, the rivets.

g, studs fixed in the short jaws, to slide in the forked plates, and to keep the long jaws from slipping off from the short jaws.

h, ferrules, or flat rings of brass, or other suitable material, sliding on the springs *a*, to compress them together, and force the jaws to grasp the papers.

k, two plates of metal, riveted on the outsides of the middle parts of the springs *a*; the rivets passing through the springs and through a horse-shoe-like plate placed between the springs, the hollow part of the horse-shoe forming a recess for a ring to slide in. The shape of the recess is shown by dotted lines in fig. 1.

l, the ring sliding in the recess, so as to be pushed in, and present no inconvenient protuberance when the clip is used in a portfolio, and pulled out when it is required to hang the clip up.

m, a pin, put through the plates *k* and the middles of the springs, near the mouth of the recess, to prevent the ring from being drawn quite out of the recess.

RAILWAY BUFFERS.

Dear Sir,—It appears to me that your correspondents on the subject of railway carriage buffers, have not sufficiently considered the nature of the evil which they seek to overcome. The remedy which they propose would only substitute for that evil another of an equally, if not of a more dangerous, character, as I will presently endeavour to show. The inequality of height of the different carriages in a train arises from two principal causes: the first is, the mixing up of new, or comparatively new carriages, with old ones, the springs of which have become permanently depressed by long-continued use; the second is the unequal loading of the different carriages. Now if the oldest and lowest carriages chance also to be the heaviest laden, which is very likely, the inequality is greatly ed; not only because of the gre flecting power of the heavier l because the springs, having los tion of their original *charge*, ar fore less able to support the wei those of the newer carriages. buffers then become as inclined relatively to each other, ready t the lighter carriages off the rail first favourable opportunity—of I allude to the present system of buffers. Now let us see how the I tean system of locked buffers, posed by some of your corresp would act. In the first place t way men who make up the trains have to force the convex buffers carriage into the correspondi buffers of the next; either by ing the highest carriage of the by lifting the lowest one perha 4 inches. Would this be an eas Suppose it however to be accom the consequence would be this, t kind of inequality would be ex for another. Before the buffe forced to "match," the train w in a line something like that repr in fig. 1. Afterwards it would the appearance shown in fig. the springs endeavouring to their horizontal position by l the buffer rods. If the carria then unequally loaded in the I have before described, this tend bend the rods is much increase their action on the buffer springs impeded. This, however, is worst of it. Suppose two lightly carriages coupled together, but a to heavily laden ones at their o ends; the outer buffer rods of t carriages then become levers, by m which the heavy carriages are end ing to lift the inner ends of th ones—the axles nearest to them as fulcra. The sketch, fig. 3, wil my meaning more clearly:

A A are the heavy carriages, B light ones.

It may be said that the force exerted could not be great; but who may have seen a railway co as I have done, knowing the tend the carriages at such a time to "re will be careful to avoid assisting tendency, even in the slightest de

The remedy for these evils,

Fig. 1.

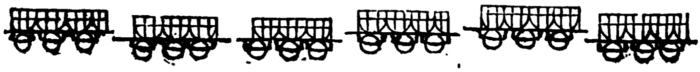


Fig. 2.

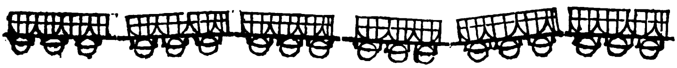


Fig. 3.

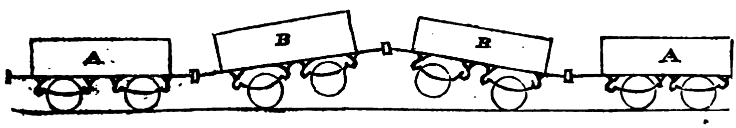


Fig. 4.

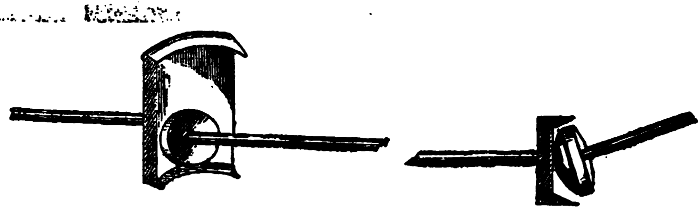


Fig. 5.

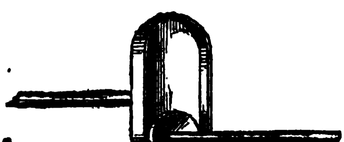
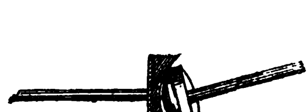


Fig. 6.



me, a very simple one. Let one pair buffer-heads on each carriage be of oblong form, rather wider than the mmon circular buffer-head, and twice high. Let the face of this oblong ffer-head be made hollow, or concave, *rtically*, and the corresponding circu- r convex buffer of the next carriage ill then be sure of a proper contact, however unequal the carriages may be in height. Each carriage will then have its springs free to act according to its own load, and will always preserve its proper horizontal position. A guard, plate at the bottom and top of the oblong buffer-head would be useful in case of such accidents as Sir George Cayley describes.

This form of buffer had occurred to me some time before the subject was broached in your pages.

I am, Sir, yours, &c.,
JAMES ROCK, Jun.

Hastings, September 6, 1847.

P. S.—The ends of the oblong vertical buffer may be circular if preferred, as shown in fig. 4; and the guard plate may be carried all round, instead of the bottom and top only: in which case the face may be flat instead of being hollowed out, which may be an advantage in going round a curve, by keeping the thrust of the convex buffer nearer to the centre of the other, as will be seen by the horizontal sections, figs. 5 and 6, the former of which shows the nature of the contact with a flat-faced oblong buffer, and the latter that with a concave one.

REMARKS ON CALCULATING THE POWER AND EXPANSION OF STEAM; WITH A PRACTICAL APPLICATION OF THE SAME TO DETERMINE THE ACTUAL WORKING POWER OF THE ENGINES ON BOARD THE "WASHINGTON" STEAM-PACKET, &C.

Sir,—I have very often been much pleased with the mathematical papers which have appeared at various times in your scientific Magazine, but more particularly those that were applicable to mechanical subjects. I believe that they cannot fail of being very acceptable and of vast utility both to amateur mechanics and practical engineers. I was particularly delighted with the article by "A. H.," in No. 1248 of your Magazine, and pages 31, 32, 33, and 34, upon the subject of cutting off the steam, and then letting it expand, so as to fill the cylinder and finish the stroke of the piston. As I have been out of practice of the differential calculus for some years past, I paused a moment when I read the formula,

$$\text{“} P.\, a\, (\log_{\varepsilon} b - \log_{\varepsilon} a), \text{” \&c.,}$$

and asked myself what sort of logarithms are here intended to be used? For I saw at once that the common, or Brigg's logarithms, would not do. I then immediately remembered that the Napierian, or hyperbolic logarithms, were the kind used in finding fluents and the sums of infinite series, &c.

I then, in a few minutes, completed the series in the calculation for off the steam at one-tenth of the of the piston. I believe that, i calculations, we ought to consid steam in its unexpanded state, jus instant it is cut off, as being t term of the series; and the first sion, or when it fills just double ginal volume in the cylinder, a the second term of the series; second expansion, when it fill times its original bulk, as being th term in the series; and the ninth sion, when the steam occupies te its original space in the cylinder, a the tenth term of the series, &c. am correct in this view of the sul believe that I must be right in t of the process. I was much ple find my calculation agree so exact the result given in No. 1248, pa where the writer gives the press fore expansion as P=1000 lbs., accordingly, that the work done pansion, through the first foot, =693·1 lbs.; the second expansi three feet of the cylinder, =405· the fourth foot, =287·7; the fift =223·1; the sixth foot, =182· the seventh foot, =154·2; the foot, =133·5; the ninth foot, = and the tenth foot, =105.4 lbs.; t of the series being 2302·6: bein cisely the result given by "A. H

I have made use successfully formula, in a very simplified fo determine the actual working po the engines of the *Washington* steam-packet, which are rated as of 1,000 horse power, but wh shown, by these calculations, greatly short of performing the of duty claimed for them; and th modification of the formation found equally applicable to all steam engines where the cylind not filled by a continued supply f boilers, and the steam is cut off at part of the stroke of the piston.

I believe these calculations useful to many of your practical r and therefore, Mr. Editor, shou deem my humble contribution wo a place in your very valuable publi I shall feel much obliged to you insertion.

The *Washington* ocean steam two cylinders, the piston of each o makes a stroke of 10 feet; diam

each cylinder, 72 inches; area of each, 4071 square inches; and each equal to 500 horse power. Taking the one horse power at 228 lbs., as given by Watt, 500 horse power would be equal to a pressure of 114,000 lbs. on each piston, at 28 lbs. the square inch, before the steam is cut off to be expanded. Here we have P = 114,000 lbs.; and the hyperbolic logarithm of 2 = 0.693147, of 3 = 1.098612, of 4 = 1.386294, of 5 = 1.609438, of 6 = 1.791759, of 7 = 1.945910, of 8 = 2.079441, of 9 = 2.197225, and 10 = 2.302585. Now, by multiplying P = 114,000 lbs. into each of the foregoing hyperbolic logarithms, we shall obtain the following results, which I have given in a tabulated form, which are enclosed in the subjoined sketch of a cylinder, where A represents the bottom of the cylinder, and D the top thereof, B the piston, and BD the piston-rod. In this sketch it is not intended to show the proper thickness of the piston, but it is represented merely by a straight line, in order to give a clearer idea of the different expansions. The cylinder is represented 10 feet long, and 6 in diameter, as a matter of course. In the *Washington* steamer, the internal length of each cylinder is 10 feet + the thickness of the piston, &c.

1	2	3	4	5	
Areas.	Diam.		H. P.	D	10
428·9	23·4	*k*	12,011 = 52	262,495	9
479·5	24·7	*i*	13,428 = 59	250,484	8
543·6	26·3	*h*	15,222 = 67	237,056	7
627·9	28·26	*g*	17,573 = 77	221,834	6
742·3	30·75	*f*	20,785 = 91	204,261	5
908·5	34·	*e*	25,439 = 112	183,476	4
1171·9	38·6	*d*	32,815 = 144	158,037	3
1650·	45·8	*c*	46,203 = 203	125,222	2
2822·	60	*b*	79,019 = 346	B 79,019	1
4071·	72	*a*	114,000 lbs.		
			A		

The column No. 5, shows the amount of work done by the expansion of the steam for each foot of the cylinder; and thus it is shown that when expanded 1 foot, that is when cut off at 1 foot and expanded so as to fill 2 feet of the cylinder, the work done by the second foot of the piston will be 79,019 lbs.; and that at nine such expansions, the amount of the whole will be 262,495 lbs., of one foot of steam expanded so as to fill ten feet or the whole cylinder. Again, *b, c, d*, &c., column 3, shows the work done by each foot separately; and column 4 shows the equivalent horse power of the same. The columns 1 and 2 show the areas and diameters that would give the same power, if worked with steam of the original pressure. Hence we see that if the steam were cut off at 1 foot, the piston, of 72 ins. diameter, during the tenth, and last foot of the stroke, would do no more work than could be done by a piston of only 23·4 ins. diameter, and working at the original pressure of 28 lbs. to the square inch. We may here briefly observe that the sum of the series of nine expansions = 262,495 lbs., added to 114,000 lbs., the first term gives the total 376,495 lbs. as the work done by the entire stroke of the piston through the ten feet of the cylinder. One tenth of the sum, or 37,649 lbs. = 165 $\frac{1}{10}$ horse power, only will be the average of work done if the steam be cut off at one foot of the stroke of the piston, instead of doing the work of 500 horse power.

To render still more clear this simplified mode of applying the integral,

or differential calculus, to determine the work done by the expansion of steam in the cylinder: I will show the method I use when the steam is not cut off at an even, or aliquot portion of the stroke of the piston. Thus, supposing the whole stroke to be 10 feet, as in the former example: but instead of cutting off at 1 foot, as in the former case, we will now cut off the steam at exactly 3 feet of the stroke of the piston; and here taking the pressure as before at 28 lbs. the square inch, at which pressure, on a piston of 72 inches diameter, the force exerted will be 114,000 lbs. until the instant of cutting off, and as in this case there are 3 feet in length of the cylinder filled with steam unexpanded as it came from the boiler, to be expanded so as to fill 7 more feet of the cylinder, I consider the work done by the piston in passing through this (first) 3 feet of the cylinder, as being the integral from which we have to find the sums and the differences of the work done by expansion in the remaining part of the cylinder: and, therefore, we take 114,000 lbs. × 3 = 342,000 lbs. = P. (or A.) And according to the explanations before given, we take the first 3 feet of the stroke of the piston to be the first term; and the first 3 feet done by expansion, or when the steam fills exactly 6 feet of the cylinder as the second term, = B; and the second 3 feet expanded, or when the steam fills 9 feet (in length) of the cylinder, as being the third term of the series, = C; and the exponents, or co-efficients will be 1·2·3, all integral numbers. But the expansion due to each odd foot, taken intermediately, will be expressed by a fractional exponent; then the complete series will stand thus:

$1.\ 1\frac{1}{3}.\ 1\frac{2}{3}.\ 2.\ 2\frac{1}{3}.\ 2\frac{2}{3}.\ 3.$ and $3\frac{1}{3}.$

The hyperbolic logarithms of each of those numbers multiplied into P = 342,000 lbs. will give the sum of the expansions up to that term of the series inclusive. Thus, B = hyp. log. of 2 × P = 342,000 lbs. gives 237,056 lbs. due to the first 3 feet of expansion, and the hyp. log. of 3 × P = 342·000 lbs. gives 375,725 lbs. the sum of both B and C, or the work done by expanding the steam till it fills 9 feet of the cylinder. Then for D the 7th foot, or complete filling of the cylinder, we take the hyp. log. of $3\frac{1}{3} = \frac{10}{3} =$ 1·203973 × 342,000 lbs. = 411,758 + lbs., being the sum of all the series, or the work done by expansion by t finishing the last 7 feet of it Now to find the work done by foot expanded, we take the hy $1\frac{1}{3}$, or of $\frac{4}{3} = 0{\cdot}287685 \times 342{,}00$ lbs. the answer; and the series c will stand thus: $1\frac{1}{3} = 98388.\ 1\frac{2}{3}$ and 2 = 237056 lbs. and $2\frac{1}{3} = 28$ $2\frac{2}{3} = 335443.$ and 3 = 375725. 411758 lbs., these being the su include the amount of all the terms. And their differences w $1\frac{1}{3} = 98388.$ for $1\frac{2}{3} = 76314.$ for for $2\frac{1}{3} = 52720.$ for $2\frac{2}{3} = 45667$ 40282. for $3\frac{1}{3} = 36038$ lbs., whi ences show the work done by 2nd, 3rd, 4th, 5th, 6th, and 7t expansion separately. Then average of the work done by plete stroke of the piston, to th the series 411758 add 342000 done before cutting off the steam is 753758 lbs., one-tenth of whi + lbs. the average for each fo stroke of the piston, equal to 3 power instead of 500 horse pow

And in this manner I have f amount of work that would be each cylinder on board of th *Washington Ocean* steam pack steam were cut off at $\frac{1}{2}$ the strok h. p., at $\frac{1}{3} = 349{\cdot}7$ h. p., at $\frac{3}{10} = 3$ at $\frac{1}{4} = 298{\cdot}2$ h. p., at $\frac{1}{5} = 260{\cdot}9$ $\frac{1}{10}$ of the stroke = $165\frac{1}{10}$ h. p., i 500 h. p. in each case. These bers may be useful to persons not time or inclination to go the calculations in the manner in this article, and may desire the work done by any other eng ply by the sliding Gunter. T pose it were required to find t amount of work done by an e 120 horse power when the st cut off at $\frac{3}{10}$ of the stroke of t the proportion would stand t 500 : 330 : : 120 : $79\frac{1}{5}$ h. p.; se B (the slide) opposite to 330 first line of numbers; and then to 120 on B you will find $79\frac{1}{5}$ answer; so that, an engine rated as a 120 h. p., will, if the cut off at one-third the stroke, do no more than $79\frac{1}{5}$ h. p. for done.

This letter will show the pu much they are deceived wh read accounts of "splendid e immense power," which, as I

:rated, are in reality doing no
an one-half or two-thirds of the
ey are stated to perform. In-
ey scarcely do so much as this,
s in consequence of using the
that *beau ideal* of mechanical
ce in the minds of wealthy ma-
:ers, or eminent engineers, whose
is to substitute elegant specimens
:manship, instead of really useful
ns and economical improvements,
hey believe would lessen their
and require more skill and dili-
the construction.
ng already given a very ample
tration of the disadvantageous
n of the crank in my essay there-
No. 770, and page 92, of the
ics' *Magazine*, I believe it would
lifficult for me, in another com-
ion, to show that, by the combined
of cutting off the steam and the
power by using the crank, en-
board steam-vessels do not per-
reality more than one-third the
y are rated at. In fact, the very
wer exerted by the crank, until
erformed about one-fourth of the
compels the engineers to employ
rs and pistons of enormous dimen-
n order to obtain a GRAND PUSH
the other machinery in motion.
, indeed, the real secret why such
ve engines of monstrous dimen-
ontinue to be manufactured.
nclusion, I beg leave to say, that
t send this present contribution
: very valuable and interesting
e as a specimen of mathematical
I do not in the least put myself in
ition with any of the very talented
en who contribute to your pages;
contrary, if I am wrong in the
ions here submitted, I shall feel
l to be set right by any one on a
so very important as the one under
ration. My merit herein is of a
kind: I pretend to no more than
plifying of abstruse formula, and
the calculations into such an easy
s to be easily understood by, and
ble to, the operative engineer
chanic. I am, Sir,
have been for more than
twenty-four years past,
your constant reader,
THOMAS OXLEY, C. E.
, July 17, 1847.

CUNNINGHAM AND CARTER'S ATMOSPHERIC RAILWAY.

In our journal of the 1st of May last (No. 1238), we gave a full description of this new system of atmospheric propulsion, and pointed out some of the more remarkable peculiarities in respect of which it differs from every other system yet proposed. We have this week had the pleasure of inspecting a working model of a railway on this plan, which the patentees have constructed at Peak Hill, near Sydenham, and would recommend every one who may not have fully comprehended the mode of action devised by Messrs. Cunningham and Carter, or who may have any doubts about its efficiency, to go also and see the thing at work. The model is not on a large scale, yet still large enough to prove that the principle of the invention is sound, and one which will hold good with almost any increase of dimensions.

The model exhibits to us first a circular railway, of some fifty feet or thereabouts round, with two lines of rails, and two trains of carriages upon them. Then there is an air tube, or atmospheric main, with no valve in it, but perfectly close, which runs along the outside of this railway, and is worked (that is, which is more or less exhausted according to the working pressure required) by means of a stationary steam engine placed at one side of the railway. Next there are branch pipes, which lead off from the atmospheric train to small horizontal air engines, fixed in pairs by the sides of the railway, at three points of the circle. It is supposed that, in actual practice on a large scale, one stationary steam engine for every ten miles would suffice, but that a pair of the small air engines would be required for every 500 feet. The immediate office of these air engines is to propel the carriages along the railway, which they do in this way:—Between every pair of air engines there are three stationary horizontal wheels, one occupying the space between the two lines of rails, and the others the spaces between the rails of these lines respectively; and all the three are connected by bands; so that when motion is communicated to one of the three, it is communicated to the whole. Each carriage, again, has

attached to it, on both sides, what are called "traction" rails (*friction* rails would perhaps be a more appropriate term), which are so constructed as to fit against the peripheries of the horizontal wheels. Now, supposing a carriage to be advancing towards one pair of these air engines, it first catches against a tappet, which opens the communication between these engines and the atmospheric main, and sets both engines a going, which, in their turn, instantly put in motion the three horizontal wheels; and, as the carriage passes onwards, its traction rails come into contact with the peripheries of two of the revolving wheels, and from this frictional contact is derived a degree of propulsive power sufficient to carry the carriage forward to the next stage or pair of air engines. Then, as soon as the carriage has passed the engines, it strikes another tappet, which shuts off the communication with the atmospheric main, and instantly brings the wheels and air engines to a stand, so that they are in motion only as long as they are serving to propel the carriage, and no longer. And so the work goes on unceasingly, at a rate of velocity varying with the extent to which the atmospheric main is exhausted. For many minor details touching the slides, connecting-rods, &c., we must refer to our previous description.

During the model experiments which we witnessed, the pressure indicated by the barometer varied from 9 to 15 inches, and the speed was of all rates, from very slow to very fast—say, at least, 40 or 50 miles an hour. The speed, too, instead of consisting, as might naturally enough be anticipated, of a series of short starts or runs, each of rapidly diminishing velocity, was, to all appearance, and for all practical purposes therefore, perfectly uniform. The instantaneousness with which the trains were brought to a dead stand, when running at even the greatest velocity, was very remarkable. It resembled exactly what one might suppose would be the case were a carriage on a common road separated from the horses drawing it by a sudden severing of the traces; all the drawing power being gone, it would of itself have the power only *to stop*. Another important fact exemplified by the experiments was, the all-sufficiency of the system, even though parts of the machinery should fail One of each pair of air engines w peatedly thrown out of gear, y carriages went on as before, thou actuated by half the usual pro power. We presume that the di between the pairs of engines are culated by the patentees as to a the possible, yet extremely impr contingency, of one of each pair going wrong; but it would be still were the distances so arrange though *both* the engines of a pair fail, the transit would still continu hold it to be the next thing to a p impossibility that any two followin should wholly fail one after the o

The number of air engines r for such a system will, at first strike the reader as involving a m jectionable amount of first cost anc ing expense; but, in point of fac is nothing of the sort. The engi very simple affairs, each consis very little more than a cylinder a ton; they require no separate atte and the fuel to work them is t atmospheric pressure which everla surrounds them, and costs nothing wear and tear of the machinery en to turn it to account. The entire air engines, for any given line of r would certainly not amount to mo one-fourth of the locomotives req do the same work; and, if we add another fourth for the proba of the stationary steam engines, spheric main, and appendages, tl tem would still have an advan one-half over the ordinary stea motive plan.

The patentees calculate that a line of railway on their plan m constructed for 4000*l*. a mile, e: of the cost of roadway and rails. the proceedings of the South Railway, reported in our last N it appears that a single line, on the Messrs. Clegg and Samuda costs a mile; and double, therefore, The objection justly taken by M bert Stephenson to the atmosphe tem, on the ground of economy struction, is thus for the first tim factorily removed. The patentee late further that such a line m worked at a cost not exceeding tl fully small sum of *three-pence ha*

per mile. We subjoin the par- ı of this calculation.*

‧, then, we have a plan of pro- which affords all the advantages ıticipated from the atmospheric , without any of those drawbacks ıave hitherto clouded its fortunes, ich is not only much cheaper than linary steam locomotive system, irely free from all those dangers nsequences which are its insepar- tendants.

ulsion, by an agency which is the 't of nature—ever at hand, ever or use, and ever to be had in ex- ss abundance.

steam engines; consequently, no no smoke — no fiery ashes — no ; to person or goods—no stifling f burnt grease or tallow—*no ex- s.*

ulsion, on a plan, which though it ot exclude a remote possibility of riages slipping off the rails, pro- for their being instantly brought and by their own gravity.

agging of carriages and passengers ruction by a mechanical mad horse, ed from all control by the mere ;, perchance, of a switch (no more in its way than the waving of the branch of a tree to the horse natural), and converted from a useful servant to one of the worst possible of masters.

Speed of transit, equal to whatever steam can accomplish, with a pleasure unalloyed by the slightest apprehension of danger, and with a degree of comfort in which every sense concerned in locomotion is alike considered,—feeling, seeing, smelling, and hearing.

We have a strong faith in the system which offers such advantages as these, and cannot bring ourselves to suppose that they can long remain either overlooked or unappreciated. On main lines of traffic we do not hope to see it adopted till it has been tried on some short line or lines, and proved beyond all doubt to possess the superiority claimed for it; but were it even to be for ever confined to short lines, it will confer incalculable benefit on any country in which it is introduced. Exceedingly cheap, and as simple as cheap, requiring very few hands to work it, and but little skill in the few—it may be adopted in a great many localities, the traffic of which would not allow of the introduction of any dearer or more complicated system.

ADCOCK'S PATENT SPRAY-PUMP.

-When your correspondent "Cad- rlais" thinks proper to write in his me, date from his own place of abode, ve data, and not figures which he ls to be data, I probably may deem ı my while to reply to him. He im- ıat he was at Llanhiddel Pit, during the public exhibitions of the spray- If he *was* there, he has wilfully :kedly perverted facts; and the gen- who did me the honour to attend the exhibitions will well know how to ap- ; statements such as his. Engaged ı, Mr. Editor, in matters so import- these, it cannot be supposed that I can find time to reply to every anonymous correspondent, who, assassin-like, stabs in the dark. I have no doubt, however, that an article so utterly at variance with facts, will, like an over-dose of poison, carry with it its own antidote. The letter is malicious towards me, and an insult to the understandings of those scientific *and practical* men, who have seen the operations of the spray-pump, and have given orders.

I rely, Mr. Editor, on your impartiality for the insertion of this, and am, Sir,

Your obedient servant,

HENRY ADCOCK.

London, Sept. 15th, 1847.

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*ʼy expense of working a Double Line 50 Miles long during a period of 10 Hours, with trains from each terminus every half hour. *Six trains always running.*

						£	s.	d.
ls for 5 Stationary Engines, 100 horse power each, at 5 lbs. per horse power per hour, say 11 tons at 14s.						7	14	0
ses.			£	s.	d.			
Engine men, with relief, ...	10	at 6s.	3	0	0			
Stokers	10	4s.	2	0	0			
Cleaners	10	2s. 6d.	1	5	0			
Drivers	12	5s.	3	0	0			
Guards	12	5s.	3	0	0			
Men stationed along the line, with relief,	20	3s.	3	0	0	15	5	0
Repairs of engines with depreciation, &c., &c, at £200 per annum each, £1000; daily proportion						2	15	0
Add for contingencies						4	6	0
						£30	0	0

40 Trains at 15s. per train, £30 0s. 0d., or 3½d. per train per mile.

LIST OF ENGLISH PATENTS GRANTED FROM SEPT. 9, TO SEPT. 16, 1847.

William Hancock, Pentonville, gentleman, for certain improvements in bolts, locks, and other fastenings. September 16: six months.

CALENDAR OF SPECIFICATIONS OF PATENTS OF INVENTIONS. FROM THE PERIOD WHEN THE PRACTICE OF ENROLMENT COMMENCED TO THE PRESENT TIME.—CONTINUED FROM P. 262.

[From the Reports of the Deputy-Keeper of the Public Records (Sir Francis Palgrave).]

THE CALENDAR.

[Of the two dates annexed to each entry, the first is the date of the patent, and the second that of the enrolment of the specification.]

George Holland, of Holborn-bars, frame-work knitter: of "a new method of manufacturing and improving hosiery and various other articles for clothing and coverings," made of woollen, flax, hemp, hair, cotton, silks or fur, or mixtures of any two or more of them, by coating, covering, and uniting, with them beavers' furs, coneys' wool, hares' wool, sheep's wool, mohair, or the wool, fur, hair, or down of any animal, or any two or more of them mixed together; or any one or more of the above articles mixed with silk, cotton, or any vegetable production used for the manufacture of clothing. Cl. R., 32 Geo. 3, p. 7, No. 12. July 24, 32 Geo. 3; August 23, 1792, 32 Geo. 3.

James Tucker, of Old Store-street, smith: of an improved register stove, whereby the fire can be removed back a little or much at pleasure, or wholly extinguished, and that without making any dust or disturbance in the room, and which is also a great security against accidents happening by fire. Cl. R., 32 Geo. 3, p. 7, No. 11. July 24, last; August 22, 32 Geo. 3, 1792.

James Smart, of Emsworth (Southampton), blacksmith: of an invention of making a plough-share and share bed. Cl. R., 32 Geo. 3, p. 10, No. 4. April 26, 1792; May 16, 1792.

Abraham Hill, of Whiteley Wood, saw-maker: of "an invention of making scythes with steel blades and iron or steel backs fixed on with screws or pins." Cl. R., 32 Geo. 3, p. 15, No. 15. December 17, 32 Geo. 3; 27 Dec. 1791.

Samuel Lucas, of Sheffield, refiner: of a method of bringing iron ore, and also calx of iron, into a metallic state without first rendering either of them fluid. Cl. R., 32 Geo. 3, p. 17, No. 7. April 18, 32 Geo. 3; May 12, 1792.

Samuel Burman, of Brackley (Northampton), cordwainer: of "a newly invented half boot," having an opening at (and a water guard fixed to the v lap quarters, the cut or opening ad foot easily into the boot, the m placing and fixing the water guard ally keeps out the water and wet, whi through the laced, and other bo openings. Cl. R., 32 Geo. 3, p. 12. April 18, last past; May 16, 3, 1792.

Robert Barber, of Bilborough (gent.: of a machine for making la fishing nets, garden nets, horse net nets, game nets, or any other kind Cl. R., 32 Geo. 3, p. 29, No. 14. now last, 32 Geo. 3; June 13, 179

John Donaldson, of Tavistock-r vent-garden, gent.: of "a new method of preserving animal and v substance." Cl. R., 33 Geo. 3, p 8. Februar y19, 33 Geo. 3; M 1793.

James Axon, of Carey-street, tu carpenter: of an invention of "a for cleaning and fining raw cotton, wool." Cl. R., 33 Geo. 3. p. 2, Feb. 27, 33 Geo. 3; March 27, 17

Thomas Binns, of St. Marylebo penter: of "a new invented mac apparatus for water closets and which upon a self-acting principl such water closets or privies, wher machine or apparatus shall be fi made use of, will introduce water bason in such water closet or pr empty and cleanse the same, and the same again, leaving a proper pc clean water in the bason, and ther serving the bason clean and preven offensive smell without the manu ance or the attention of any perso to." Cl. R., 33 Geo. 3, p. 2, March 15, last; April —, 33 Geo.

Matthew Pitts, of Abinger (Captain in His Majesty's Corps o Engineers: of "new invented i ments on the steam-engine, and a vented method of generating stea its application to steam-engines, or other purpose where steam is used. improvement on the steam-engine r the piston in the great or house c the padding or stuffing whereof, wh rounds the circumference of the p so contrived that as it wears away tended and made to fit the cylinder any fresh padding or stuffing, or bein out, as has hitherto been the practic R., 33 Geo. 3, p. 2, No. 10. M 33 Geo. 3; April 23, 33 Geo. 3, 17

(*To be continued.*)

SIGNS FOR ARTICLES OF UTILITY REGISTERED UNDER 6 AND 7 VIC. CAP. 65.

'o. in e Re-ster.	Proprietors' Names.	Address.	Subject of Design.
1191	Henry Jones...............	Rose-street, Covent-garden.......	Air regulator.
1192	Bartholomew Brittain..	Waterloo Bridge-road..............	Bracket for French bedsteads.
193	William Samuel Burton	Oxford-street	Collapsible sponging bath.
1194	William Samuel Burton	Oxford-street............................	Collapsible shower bath.
1195	Swain and Co............	Oxford-street	Syrian paletot.
1196	James Dixon and Sons	Sheffield	Dish-cover.
1197	Henry Thompson	Long Acre.................................	Portable folding rocking-chair.

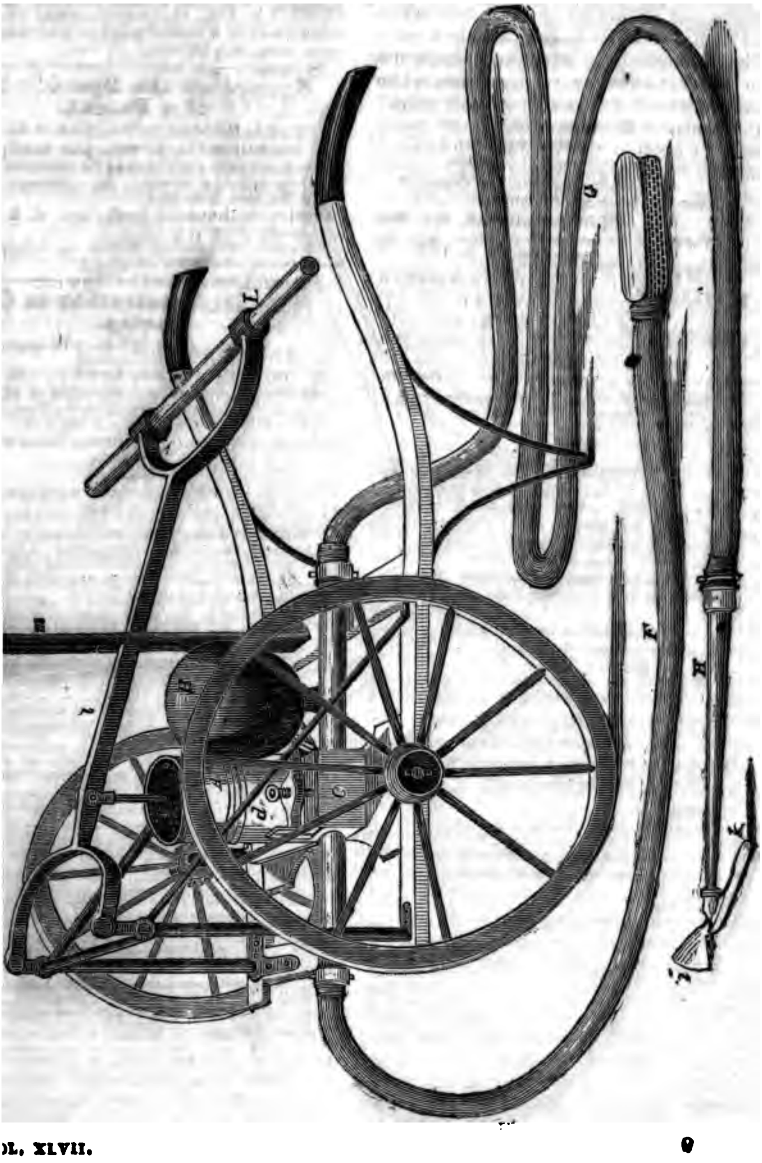
CONTENTS OF THIS NUMB[ER.]

LONDON: Edited, Printed, and Publ[ished by] Joseph Clinton Robertson, of No. 16[6, Fleet-]street, in the City of London.—Sold b[y A. and] W. Galignani, Rue Vivienne, Paris; M[achin and] Co., Dublin; W. C. Campbell and Co., H[amburg.]

Mechanics' Magazine,
MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 1259.] SATURDAY, SEPTEMBER 25. [Price 3*d*.
Edited by J. C. Robertson, 166 Fleet-street.

MR. BADDELEY'S EVERYBODY'S FIRE-ENGINE AND UNIVERSAL FORCE-PUMP.



SIR,—In consequence of the frequent occurrence of fires in farms, I was led to attempt the construction of a Fire-engine which should be sufficiently simple, of adequate power, and so moderate in its cost, as to be suitable for farmers' use. My success has equalled my most sanguine expectations, and in the machine now submitted to your notice you have, in the smallest compass, in a complete travelling carriage, a machine equal in power and superior in efficacy to the ordinary run of *Parish engines*, at half the usual cost, and capable of being worked by half the number of men—a machine that is applicable to the roughest work of a farm without any fear of injury; not a thing about it, that requires any care or attention beyond the greasing of an ordinary cart wheel.

Derangement in the valves (the lungs or vitals of the machine) is almost impossible, but, should such occur, a plough-boy could put all right in a minute, and no repairs can become necessary beyond the capacity of a hedge carpenter to execute.

One of these engines was exhibited at the recent meeting of the Royal Agricultural Society of England at Northampton, as a "FARMER'S FIRE-ENGINE," but to which, in deference to the suggestion of a Nobleman who saw it there, I have since given the more appropriate designation of "EVERYBODY'S FIRE-ENGINE, AND UNIVERSAL FORCE-PUMP." In the Royal Society's Catalogue it was thus described:—

"(*New Implement.*) A Farmer's Fire-engine, Drainer and Irrigator; invented by W. Baddeley, of 29, Alfred-street, Islington, and manufactured by M. Merryweather, of 63, Longacre, London.

"This engine consists of a single barrel force-pump and air-vessel mounted on a light two-wheeled framed carriage, manageable by one man. It has perpendicular metallic valves arranged in a separate valve-chamber clear of the works, closed by a single screw, the loosening of which gives access to the valves. It has a flexible suction-hose, through which it will draw water from a pond, tank, &c., and a canvas delivery-hose, branch-pipe, and spreader. As a fire-engine it is instantly available, while it will be found exceedingly useful for emptying ponds, &c., and irrigating lands. It n used to pump liquid manure fr tank to the cart, or from the cart tribute it over the land."

In the accompanying figure, a gun-metal pump-barrel, within works a solid metallic piston with leathers. B is a spherical copp vessel. C the valve-box, clear works. *d* is a screw working in a bar *e*, which is passed throug at each end of the valve-box; th sure of the screw *d* on the cover valve-box makes it perfectly ai On loosening the screw, the cov be taken off, the valves examin cleared, and the cover replaced w minute, without interfering wi other part of the engine. The are of gun-metal with perpen faces, without leather or any othe ing. F is the suction-pipe, of vul India-rubber, perfectly air-tight an ible at all temperatures: it is furni one end with a union screw for to the engine; at the other, it has proved rose or strainer, which gi greatest amount of straining surf strength in the smallest compass. a length of woven canvas-delive (*Vaucher's patent*) which has t portant advantage of requiring n beyond drying after using. H is per branch pipe with gun-metal and nosel; upon the nosel is swiv spreader *i*, for dividing and spread jet, so as to distribute it simulta over a large extent of surface. accomplished by bringing a plai face, or fan, over the jet anglew pressing upon the lever *k*; the at other times kept back out of by a spring on the underside lever. An effect is thus pr superior to that from a perforate while from the jet not being acte until after it has quitted the nosel, ing is impossible. This spreader thrown into or out of action in neously, without stopping the eng must be done when a perforated scoop, or slit-spreader is employe case of fire in corn or hay-sta large surfaces of weather boardi such like, the *spreader* is invalua it enables a large burning surfac extinguished in a very short sp time with the smallest possible q

'. Similar spreaders are now ely employed by the fire-police provincial towns, and by the in- companies. The engine is work- ree men placed at the handle L ever *l*, who can deliver a jet of iree-eighths of an inch diameter, of sixty feet high, or they may larger jet to a smaller height. n travelling order, the suction- d delivery hose are both perma- ttached to the engine; the suc- e being turned up and laid e the lever *l*; the delivery hose inch-pipe attached, is coiled up l upon the upright guide *m*, the pipe being laid alongside the pipe, and both secured to the y a single strap. In case of fire, has to be done is to *unbuckle one* hrow the suction-pipe into the ipply, and commence pumping! ugh this engine is but of mode- ver, from the great rapidity with t can be brought up and set to would be far more efficient in g the progress of a fire than any owerful agent applied at an ad- stage of the conflagration.

that farmers generally are be- sensible of the vast importance ious draining and irrigating, as the great advantage of manures in the liquid state, an universal ump of this kind will be found ble for many purposes; and, in tion with that of which no farm be destitute,—a good pond of ljoining the homestead and stack such an engine as the present ounteract all the worst features of arism.

gentlemen whose establishments require or warrant the mainte- of a more powerful fire-engine, sent offers much security and con- e, as well for extinguishing fire, vatering lawns and gardens, filling , &c., &c. Small country parishes ages are almost universally des- f fire-engines, in many cases no achine being within several miles m; to places so situated, the engine, at an easy cost, offers ely to supply this lamentable icy.

I remain, Sir, yours, &c.,

Wm. Baddeley.

red-street, Islington, September 3, 1847.

ON BALANCES. BY FRANKLIN PEALE, CHIEF COINER OF THE MINT OF THE UNITED STATES.

(From the *Franklin Journal.*)

In order to insure precision and regularity, to obtain facility and rapidity, and, above all, to avoid liability to error, it has been found necessary to combine, in the balances used in the mint, not only all the arrange- ments known to us that have heretofore been found important, but also such im- provements as have been the growth of our own experience.

The result has been satisfactory, in a remarkable degree; so much so, as to be a subject of surprise to the most experienced of the corps of officers of this establishment.

In the present communication, no attempts will be made to establish claims of invention, either for ourselves or others. In fact, it would be impossible to do so with justice. Balances of every variety of structure have long been made, and may be readily met with; and all that we can now claim is, after much experience in their use, to have combined their best parts, and, in doing so, to have introduced such modifications and adaptations as have been found desirable.

In the balances of which this notice treats, two considerations have claimed particular attention: the first is precision, the second construction.

Under the former head, a descriptive no- tice will embrace remarks on such provi- sions and operations as are deemed import- ant; and under the latter, a description of construction, illustrated by engravings of the balance, as erected, and of the separate parts in detail.

To obtain the greatest degree of uniform precision, it is requisite that the beam should be lifted from a state of rest in a perfectly level position, and that the stirrups should be lifted, simultaneously with their loads, from their rests or supports; also that the oscillations of the stirrups should be pre- vented or checked at the earliest moment; and, finally, that the whole system should be left at liberty with delicacy and exactitude, so as to remain in equilibrium or vibrate, as the case may be.

To command the above conditions, the beam should be supported upon cones, at each extremity, adjusted level with each other, from which it is lifted by a plane, which rises under its centre knife-edge, and to which it is returned by its depres- sion, the cones guiding the beam to the same position exactly from which it was elevated.

The stirrups, in like manner, should hang upon hollow cones or V's, so as to be taken

up from, and returned invariably to, the same position.

The support for the centre-knife edge, as well as the hangers which rest upon the knife-edges at the extremities of the beam, should be planes, and not portions of hollow cylinders, as is usual.

The beam should rest upon its cones, and the stirrups should be supported by their V's at such heights as to relieve entirely the knife-edges, with a sufficient space between them and their respective planes to permit inspection and wiping, when it may be needed. This construction admits of the placing of the weights, &c., and guards the knife-edges from the consequences of displacement during use.

The beam should be raised by the elevation of the centre plane, subsequently lifting with it the stirrups, with their weights and load, and all oscillation checked by platforms placed in the table under the centre of the stirrups, which should be made to rise simultaneously, and should be counter-weighted to the requisite delicacy.

The descent of these platforms, effected by the pressure of a finger on a lever conveniently placed, will leave the stirrups, &c., at liberty to vibrate, or bring the beam to a horizontal position, at the will of the operator; being a convenient, certain, and rapid method of manipulating, not equalled by any other arrangement, and, in fact, essential to a well-constructed balance.

The knife-edges should be constructed of the best cast steel, hardened to the utmost ability of that metal, and the planes upon which they bear should be made as true and perfect as possible; those for the finer or more elaborately-finished beams, should be of agate or chalcedony.

Having thus concisely stated the essential qualities in balances for accurate and rapid weighing, it will be proper to explain the construction by which these qualities are acquired, being the second branch of this essay. In explanation of this, reference is now made to engravings which accompany this notice: one, exhibiting a front view of the whole; the other, the parts separate and in detail.

Description of Engravings, with Explanatory and General Remarks.

Fig. T represents a front view of the balance, on a scale corresponding to a beam four feet in length, suited, in its proportions, to weigh one thousand dollars in silver. The weight to which it is limited should not exceed one thousand ounces troy.

A beam of three feet in length is suited to drafts of five thousand dollars in gold coin, and the maximum weight should n in any case, three hundred ounces

The proportions exhibited in th may be maintained throughout for sizes, or any other, either greate than those which are stated.

A table, marked A, is furni levelling screws upon the front edge, and at each end, marked b; ling screws are marked b, and thei in the table (the view of the und which is given) are marked c.

The balance is intended to be pl a counter, or any other firm sup the table levelled by means of the s described, its true position being by a plumb-line and weight seen rear opening (c) in the column; th line and weight being marked d.

The column marked C contain ing apparatus, and supports the marked D. The cap-plate guides apparatus, and supports the V's, cones, for the stirrups, and is str and stayed by braces, marked E; tion of which braces is cruciform cular ends, for firm bearing upon and base of the column, to which secured by screws.

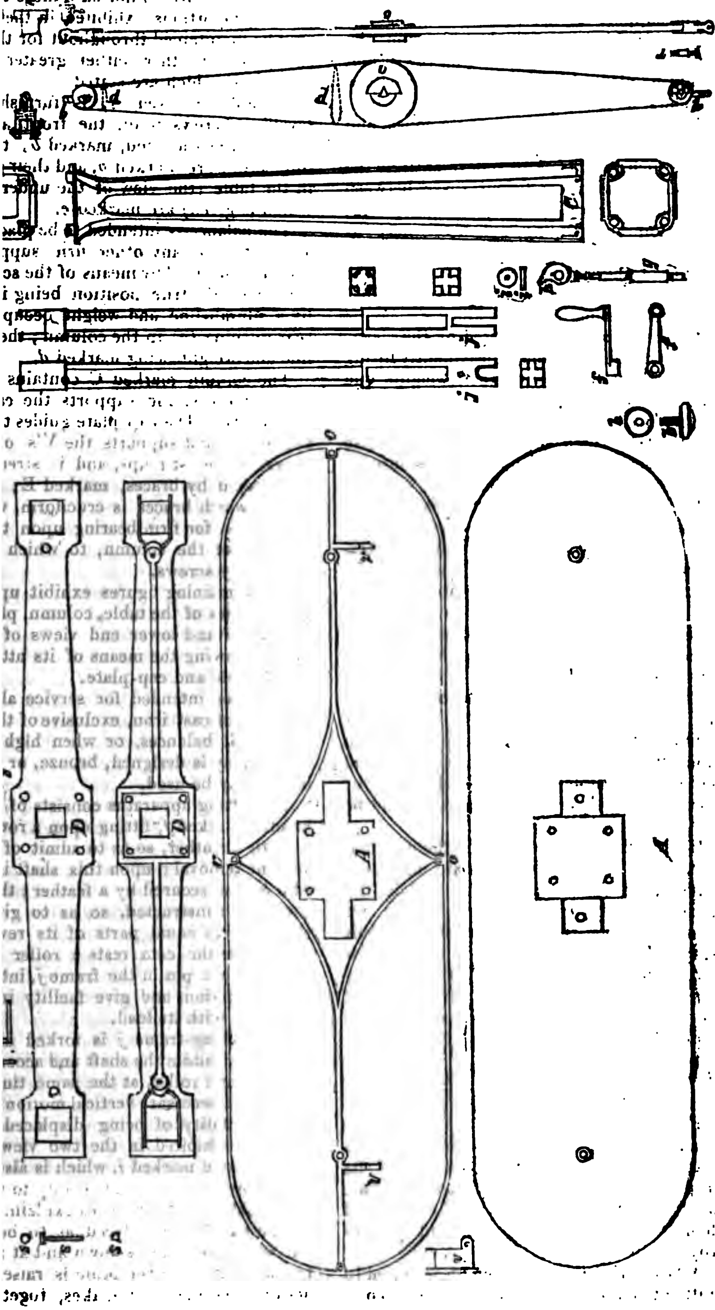
The remaining figures exhibit under views of the table, column, also upper and lower end views c lumn, showing the means of its a to the table and cap-plate.

Balances intended for service be made of cast iron, exclusive of For small balances, or when hi and display is designed, bronze, brass, may be used.

The lifting apparatus consists o handle, marked f, fitting upon a r g, with a feather, so as to admit c venient removal; upon this shaft cam h, also secured by a feather carefully constructed, so as to g elevation to equal parts of its r and upon the cam rests a roller turns upon a pin in the frame j, i reduce friction, and give facility the beam with its load.

The lifting-frame j is forked so as to straddle the shaft and acc the cam and roller, at the same ti allows the necessary vertical motio the possibility of being displace which is exhibited in the two vie lifting-frame marked j, which is al panied by sections in proximity to which they are intended to explain

The handle is so placed, as to t left when the beam is down and it to the right when the beam is rais act of weighing, and makes, toge



the cam, more than three-fourths of a revolution, the cam having a very slight depression upon its upper or highest point, into which the roller falls, maintaining it in its position when the beam is raised. It is then extended beyond the centre of the roller, so as to be stopped at the limit of motion, as exhibited at the part *h*.

The lifting-frame is forked at the top for the accommodation of the beam. Upon it rests the plane, the top and side view of which are marked *k*, for the support of the centre knife-edge, secured to the frame by screws. In balances of ordinary construction, this plane may be made of hardened cast steel; in finer instruments, of bronze, or brass, with an inserted block of polished agate, secured by fusible metal, or cement.

The position of the handle, lifting-frame, &c., are exhibited with sufficient clearness in the front view, fig. T.

The cap-plate, fig. D, is constructed with horizontal spaces at the centre and each end. In the middle it is secured to the column by four screws, and to the braces B in the same manner, the holes for which are marked in all the views.

The square opening in the middle serves as a guide and support to the lifting-frame, which must be accurately fitted, so as to prevent any lateral play.

The horizontal spaces at the extremity of the cap-plate support short pillars terminated by cones, upon which the beam rests; these pillars are secured to the cap-plate by screws passing through it from the under side, the holes through which they pass being large enough to admit of the adjustment of the beam to its proper place, previous to their being permanently fastened down.

The details of these pillars are given in fig. *l*, the cones being constructed of cast steel, hardened and polished.

The same space also supports the V's, or guide supports of the hangers, the V's being marked *m*, and the hangers *n*. All these parts have been devised with reference to the simplest and most economical construction consistent with the requisite accuracy, and for affording the greatest facility in the final adjustment of the balance.

The most important part of the balance is the beam, the form and material of which, both with reference to use and construction, have been carefully considered. Fig. *o* exhibits side and top views. It will be observed that the beam is perfectly simple in its form, thickened at the centre and extremities, for the security of the knife-edges, the arms being diminished in depth, regularly, from the middle to the extremities, a section in any part of which would represent a sharp wedge, with its e ties rounded, as shown by the dott at *p*, the thicker being the upper edg beam. The projections marked *q* supports of the beam when at re conical cavities, indicated by dotte being made to fit the cones marked

This form of beam affords facility struction, being composed of strai faces without ribs, or curves; is well to maintain its form when loaded; the least surface for accumulation and is readily wiped when it may b sary. The means of adjustment length of arm is exhibited in fig. *r*.

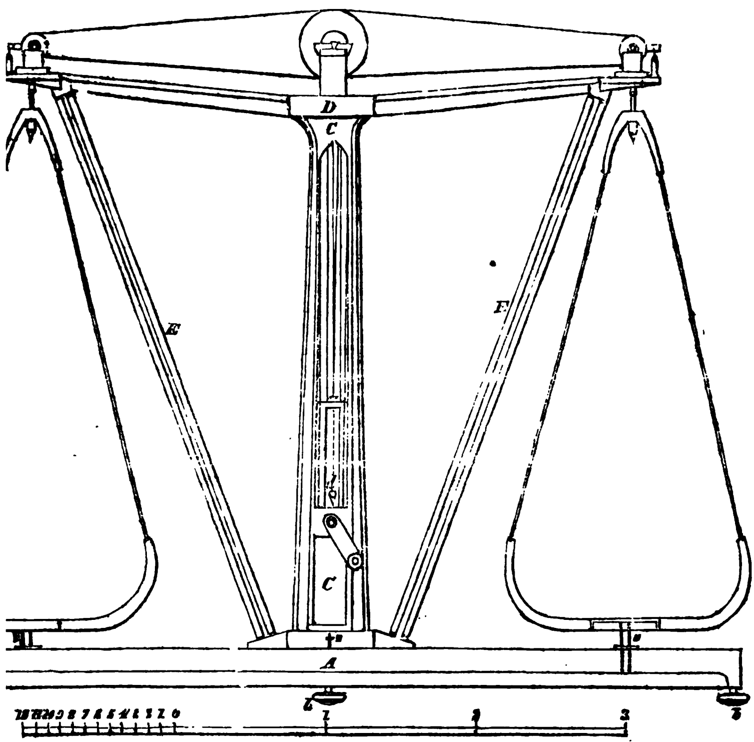
As a general rule, convenient and ble means of adjustment are to b cated. Balances should be construc reference to the use to which they tined, and the necessary accuracy ar bility given in construction. It will b it is believed, more inconvenient sirable, to attempt to change the se of a beam devoted to different uses. a person might have sufficient me skill to use a balance and weigh ac whilst it is in order, who would b embarrassed by the consequence change in the centre of gravity, the accuracy and sensibility resp without consciousness of the c knowledge of the effects. A repe the remark, that prominent and a means of adjustment are to be de will be excused, as having a ten invite to attempts at adjustment b competent and unskilful, or it m derangement by the meddlesome.

The material best suited to the c tion of beams will depend upon poses to which they are destined. usage they should be of roll brass, leable alloy of copper and tin, well by heavy hammering. The diffi procuring castings perfectly sound, from "blows," being a sufficient re the rejection of cast metal of any k

It will be seen that the needl balance, which is the subject of des is pointed downwards, and there reasons for this disposition. In place it is directly before the eye operator, and therefore more conv use, than it is when elevated above. it may be made longer than the arm beam, and will consequently de larger arc, and thus give more disti cations, whilst the whole arrangem occupy no more space than is requ the other parts; and, finally, the protected from external injury by the frame and column, in the centre of is placed.

parts which remain to be described ɐn usually considered of minor im- ɐ, but experience has shown that this is scarcely a just one, inasmuch as ɔrd facilities for accuracy and rapi- t leave no doubt of their value, and em in a most important position in . The parts now alluded to consti- system by which the operator is en- ɔ find the equilibrium of which he is in search. It consists of the pedestals, as they have been termed, marked *s*, and the parts connected with them, marked *t*, *u*, *v*, and *w*; a light shaft made of tubular iron *t*, supported by pivots *u*, which pivots are screwed through a piece cast on the under side of the table, marked V; upon the ends of this shaft there are levers W, upon the ends of which levers, when in place, the pedestals rest.

Fig. T.



emaining part of this system is a ırmed lever, placed in the middle of *t*, and marked *x*; it is connected with the trigger *z*, represented in s in plate I, with the same letter. ıe other end of the lever *x*, there is t *y*, capable of adjustment by a ıpon which it traverses, so as to be ıed to, or receded from, the shaft *t*. ction of this system is easily under- ts whole object is to depress the s by sufficient force, applied by the the trigger, the counter weight re- them to their original position after val.

l be seen, by reference to the figures, that the under sides of the stirrups have a space represented by dotted lines, in which the platforms are placed, which allows the stirrups to oscillate within its limits, but beyond which they cannot move. This construction is intended to guard the hangers from displacement, and to prevent injury by too much movement of the stirrups; an accident very likely to occur when the pans or weights are hastily removed, especially in the use of the larger balances with heavy weights or large masses.

The cavity, whose object was described in the last paragraph, forming the under side of the base of the stirrups, is turned as truly as possible in the form of a portion

of a sphere, whose radius is its distance from the bearing of the knife edge. The platforms are adjusted by means of the counter weight, so as to press lightly up against the stirrups, and to follow them when raised.

It is found convenient in practice to turn the handle of the balance but a small portion of its movement, if the weights are not equal on opposite sides, a circumstance to be expected when searching for a weight. The heavy side will remain down, and the needle will indicate whether addition of weight, or its removal is requisite. These trials are continued until the platforms follow up the whole lift, the needle remaining opposite the middle line of its scale, until the handle is stopped by its limit of motion, where it remains. The finger, then, by pushing down the trigger, will depress the platforms; when smaller weights are employed, until the needle indicates equilibrium.

In this balance there is little or no embarrassment from oscillation, because the stirrups immediately accommodate themselves to the position of the weights, the light pressure permitting them to take any position required by the load; nevertheless, having sufficient power from their pressure to prevent any swinging. If from any cause the stirrups should be in motion, three consecutive depressions of the platforms will bring them to a state of rest with absolute certainty, and with a loss of time so short as to be entirely immaterial.

The stirrups are connected with the hangers by a rod, which are double-jointed, as near to the hangers as possible, so as to allow perfect freedom of motion; at the same time, so well fitted as to allow no change of position in the parts. On the lower ends of these rods, there are screws and nuts, to regulate the height of the stirrups, together with a jam nut, to prevent any change after the adjustment has been satisfactorily made.

The bases of the stirrups are designedly made small, requiring the use of a dish on the one side, and a platform for weights on the other. This dish and platform being made of equal weight, renders the use of a counter weight unnecessary; and as the balance cannot be used without both, the liability to mistakes from this cause is entirely avoided.

For the adjustment of weights, or any other use of balances requiring the greatest degree of delicacy and care, it is necessary to protect the instrument and the operation by a case, with doors sliding vertically, and glazed, so as to permit inspection, undisturbed by currents of air. This arrangement, entirely essential for such inadmissible for ordinary weighing ing too much delay in the nece opening and shutting the doors.

In the balance for weighing gol which was placed in the exhibitio Franklin Institute in 1846, and whi in use in the weighing and counting the chief coiner's department in t of the United States, all the par the exception of the stirrups, are by plate glass, inserted into the fra as to protect the balance as much as from currents of air, dust, and ext fluences of all kinds. This balance made, with the utmost care in all upon the principles detailed in the f notice, and the result has been sat in the highest degree. In illustr which, it may be stated, that with mum load of six hundred ounce hundred on each side, it is sensibl ten-thousandth of an ounce. Thi not mentioned as very remarkable, it is comparatively easy to give gre bility to balances: but it is worthy that it is invariable in showing thi fraction of its load. As regularity greatest value in operations with we may be excused for drawing atte a quality of so much importance.

HORÆ ALGEBRAICÆ. BY JAMES ESQ., M.A., BARRISTER-AT-LA

(Continued from page 151.)

IV. CLASSIFICATION AND NO CLATURE—IMPOSSIBLE TIONS—SYMBOLS.

According to the aspect unde we regard them, the various problems to which the title IN MINATE is in general applied, a separation into two great classe ARITHMETICAL and the SYMBOLI

Under the former division woul those questions in which we are re to satisfy certain conditions by qu of a given numerical form; take, of instance, DIOPHANTINE analys

To the SYMBOLICAL class of I minate questions belong those in

(a) Professor J. R. Young, at p. 259 of his (London, 1834), observes that "Dioph Algebra is that part of analysis which n the finding particular rational values for expression† under a surd form." He sepa Diophantine from the other indeterminate p

† This is evidently a misprint for "expressio corrected in the last edition. The sense is invert omission of the "s."

terminateness of the problem is the means of satisfying certain ...al conditions. Besides the many instances in which advantage is be taken of the indeterminate- a question (a), there are two uni- d general methods in which the of certain algebraic problems of s is reduced to a systematic form se of procedure. I allude to the of Mr. Jerrard (b), and to my thod (c). Were I called upon ist a name for Mr. Jerrard's ana- should propose to term it the OF VANISHING CO-EFFICIENTS; my own (which is a kind of SYM- DIOPHANTINE method), I think he DIOPHANTIC METHOD, or ME- F VANISHING GROUPS, would not propriate.

Instances of the application of od of vanishing groups to ana- eometry will be found in the last of this work (d).

at volume (e) I have also touched e subject of a class of equations, vidual of which I have discussed resent set of papers. The class allude to is that of IMPOSSIBLE ns. By the term "impossible," not be understood to mean arith- mpossibility. In the latter sense ord} a quadratic with two unreal, ry, or "impossible" roots, would impossible equation." But such tion is only *arithmetically* or *nu- lly*, not *algebraically* impossible: y the term IMPOSSIBLE, as used 123 of the last volume of the periodical, I mean to denote an n *algebraically* or *absolutely im- e*; and in such sense I shall con- use the words "impossible equa-

simplest instance of an impossible i will perhaps be found in what y term the INCONGRUITY $1=2$. example of an impossible equa-tion will be found in the equation (4) of page 151 of the present volume. But, as we have seen at that page, the absolute y or algebraically impossible equation (4) may be shown to involve an impossible relation or INCONGRUITY similar to the one just given. And it is not easy to see how an equation can be algebraically or *absolutely* impossible, unless it involve some contradiction or inconsistency expressible by means of a numerical or arithmetical incongruity. In fact, a reflection on the investigation of page 151, suggests almost irresistibly the following proposition,—viz., that *whenever the solution of a given equation is absolutely impossible, that equation involves in itself a numerical incongruity.* Remarks on any supposed converse of this proposition are quite unnecessary. But I shall probably have an opportunity of saying more on this proposition itself when I come to continue and generalise the discussion of page 151 of this volume.

My present object is, however, to revert to a subject the discussion of which I commenced in the last (f) and have continued in the present (g) volume —that of the meaning of symbols, or, as Mr. Woolhouse has termed it in the course of some remarks upon a different description of questions, "the general theory of analytical results" (h).

Upon the controversy between Mr. Young and Mr. Woolhouse I wish to be understood as offering no opinion whatever. My only wish is to avail myself as well of the labours of the latter distinguished mathematician as of the able philosopher of Belfast. And much of the controversy has a bearing upon the discussion just alluded to.

Mr. Woolhouse remarks (i) "that the original equations, which express the analytical conditions of a problem, cannot include any extraneous conditions with those expressed in the enunciation, and that they must therefore comprehend, in their analytical results, every solution that the problem is capable of receiving. The equations, however, may not include certain other implied conditions, dependent on the peculiar nature of the inquiry, and therefore may yield some additional solutions incompatible with the conditions so implied." Hence,

(a) For examples of this see *Mechanics' Magazine*, vol. xlvi., pp. 177—178; and page 419, right column.

(b) His *Mathematical Researches*; see also his ... the *Philosophical Magazine*, s. iii., vol. ... 202—203; 478—480; vol. xii., pp. 315—

(c) ... which see *Mathematician*, vol. i. page ...; ii., page 97.

(d) The places cited *supra* page 150, note (b).

(e) Page 123.

(f) Pages 490, 516. (g) Pages 13, and 136.

(h) *Phil. Mag.*, s. iii., vol. viii., p. 399. (i) Ibid.

as a general rule, we shall have, from a number of results, to select those of which we are in quest. But what is to be our guide in the selection or exclusion of results? Mr. Woolhouse would reply (j); "The exclusion of inadmissible solutions" "rests with the nature of the problem and not with the forms of its analytical conditions." And this would also, if I am not mistaken, be the reply of Professor Young. In referring then to a "scrutiny of the symbols," (k) as a means of discriminating the true result, I have the appearance of differing from both the authorities above alluded to. To avoid the semblance of being in a position which would afford so strong a presumption that I was in the wrong, I beg to say that, without denying that we must refer to the conditions of the problem in order to obtain a true result, the question with me is how far we can carry those conditions through all our subsequent operations and up to the final result—how far we can "take the expressions *immediately* deduced in the investigation" (l) to use, what I believe to be, Mr. Woolhouse's own words—in short how far we can take those expressions, and those only, which are the solutions of which we are in search.

In such a result as that obtained at page 517 of the last volume (m) I see nothing discouraging (n). The difficulties which arise commence with *irrational* or *congeneric surd equations* to which we have been conducted in our researches on symbols. And before we proceed further with such researches it will be as well to endeavour to obtain a little further insight into the nature of surd equations, to the further discussion of which I shall proceed in another paper.—(*To be continued.*)

The following corrections should be made in my papers in the preceding (xlvith) volume of this work:

Page 124, col. 2, line 4 of the note, *for* × *read* +.
Page 179, col. 2, line 3, *for* y *read* y^3.
Page 247, col. 1, line 14, *for* "isololated" *read* "isolated."
Page 492, col. 2, line 3, *for* B′ *read* *B′*.
Page 568, col. 2, line 16, *for* "*Nouveax*" *read* "*Nouveaux*."
Page 569, line 2 of my *Postscript*, *for* "*notes*" *read* "*Notes*."
And the following in the present volume: Page 151, col. 2, line 14, *for* (3) *read* $F(x)=0$.

(j) *Phil. Mag.*, s. iii., vol. viii., p. 399.
(k) *Supra* page 13.
(l) *Phil. Mag.*, s. iii., vol. viii., p. 298.
(m) See the question in col. 1.
(n) We may call 40 the *primary* and 60 the *secondary* solutions.

MR. CRADDOCK'S STEAM-ENGINE I[MPROVE]MENTS.—THE COMPRESSED AIR [SYSTEM.]

Sir,—All the essentials in t[he plans] and arguments Mr. Craddock [has ad]vanced in favour of high-pressur[e steam] have frequently been enforced [in the] periodical literature during the [last few] years. For instance, it has bee[n shown] that fuel may be reduced tw[o-thirds,] and the twofold saving thus ef[fected on] a voyage to New York, in cost [of fuel] and tonnage, have been likewis[e shown;] that two cylinders are necess[ary, and] that *one* slide-valve only is requ[ired for] working them (which, I belie[ve, is a] patented claim); that the safety [of high-]pressure steam, with divisional b[oilers,] both by calculation and reasoni[ng, is] much greater than the low-[pressure] chambers now in use; that the [quantity] of steam to be condensed will onl[y amount] to one-third in relation to th[e power] exerted; and that, if it is expedie[nt, in] effecting so large an amount of sa[ving as] two-thirds, to change the powe[r of the] engines in accordance with the [state of] the weather, the best practicab[le mode] is, by working a greater or less [number] of fires, and thereby varying the [pressure] in the boilers, by which expedi[ent the] number of expansions will alway[s be] constant, and the cost will alwa[ys be in] the ratio of the difference; and [such] engines—the preceding precautio[ns being] carefully attended to—will be w[orked, as] regards fuel, at the least possible [cost,] which is not the case in worki[ng with] expansive gear. Giving motion to [the con]densing pipes, I think is new, [and pro]bably valuable; for one of the [great] essentials to the introduction of d[ivisional] boilers, is the indispensable use [of fresh] *water*. To this, and the fears ent[ertained] of high steam, occasioned by the i[mproper] construction of boilers for its pro[duction,] is to be attributed in a great mea[sure the] strong prejudice which has hith[erto op]posed its introduction. But t[he first] vessel sent across the Atlantic, w[ith these] combined machinery, and with t[he high-]pressure expansive principle full[y deve]loped, will commence a new era [in steam] navigation.

Allow me to offer a few rem[arks on] the compressed air system. I[n com]pressing an elastic fluid into a [smaller] space, it is quite clear that as muc[h power] will be required to effect it, by [any] suitable machinery, independent

.., as it can possibly return by ...t perfect system of expansive ... its application as an impelling consequently, if a fluid so combe applied to a piston *wire* drawn ... chamber, the power so applied ...nany times less than the cost of ...sing it, and the loss enormous, ...ared with the use of steam direct ... boiler.

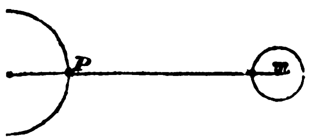
I am, Sir, yours, &c.,

ALPHA.

...use, London, ...24, 1847.

...XPRESSION FOR ACCELERATION (P. 231) SIMPLIFIED.

...-As every attempt to illustrate or ... a difficulty finds ready admit... to your useful columns, perhaps ...owing illustration of the expres... acceleration given in col. 1, page ... the current volume may not be ...table to some of your junior ...:



...M and *m* be the masses of the ...nd moon; P a given particle or ...n the surface of the earth: put ...R, and *m* P $= r$. Then, since the ...tion is as the masses directly and ...quares of the distances inversely, ...e

...force of M $=F'$: Accel. force of ... : M : *m*, when *both* masses are ...d to be at the distance r.

$$F' = B\,\frac{M}{m}\,\ldots\ldots\ldots\ldots (1).$$

..., Accel. force of M $=$ A : Accel. ...f M $= F'$: : $\frac{1}{R^2} : \frac{1}{r^2}$, when the mass ...upposed to be in *both* positions ... *m*.

$$F'\frac{r^2}{R^2} = B\,\frac{M}{m}\cdot\frac{r^2}{R^2}\ldots\ldots\ldots\ldots (2).$$

... is the same expression as that ...by your able correspondent, "A. ...n the passage cited. From (2) we have $B = A\,\frac{m}{M}\cdot\frac{R^2}{r^2}$; and if, as directed, we take M $=1$; R $=1$; and the known accelerative force of the earth at its surface $=$ A $=\mu=32{\cdot}2$, we obtain $B = m\frac{\mu}{r^2}$; where *m* and *r* are the units of mass and distance as measured by the units M and R respectively. The same proportion for A and B as in eq. (2) might also have been obtained by considering that when the *distances* are equal the forces are as the *masses;* when the masses are equal the forces are inversely as the squares of the distances; therefore, when *neither* are equal, the forces must be as the *product* of the *masses* into the inverse squares of the *distances*. Perhaps *both* methods will not be considered unsatisfactory.

"A. H." deserves the thanks of every teacher and student of mathematics, both for his valuable and instructive "Remarks," and his illustration of the *correct* meaning of the series for the sine and cosine of any angle. Hoping he will excuse my attempt to *explain* his *explanation* of attraction,

I remain, yours respectfully,

THOMAS WILKINSON.

Burnley, Lancashire, Sept. 20, 1847.

A METHOD OF DESCRIBING THE EVOLUTE OF THE ELLIPSE.

Sir,—Having frequently required the evolute of the ellipse, I have adopted the following method of describing it, which is independent of all calculation. Let a, b, be the semi-axes major and minor C A, C B of the ellipse B L A. The equation to the ellipse is

$\left(\frac{x}{a}\right)^2 + \left(\frac{y}{b}\right)^2 = 1$, and the equation to its evolute is

$$(a\,x)^{\frac{2}{3}} + (by)^{\frac{2}{3}} = (a^2 - b^2)^{\frac{2}{3}} \quad (1).$$

If a straight line move so that its two extremities are always in two straight lines at right angles to each other, it will always be a tangent to the curve $x^{\frac{2}{3}} + y^{\frac{2}{3}} = r^{\frac{2}{3}}$ (2) where r is the length of the moving line.

Equation (1) may be put under the form

$$x^{\frac{2}{3}} + \left(\frac{b}{a}y\right)^{\frac{2}{3}} = \left(\frac{a^2-b^2}{a}\right)^{\frac{2}{3}} \quad (3).$$

Take r, such that it

$$= \frac{a^2-b^2}{a} = \frac{a^2e^2}{a} = \frac{SC^2}{CA}$$

$$\text{also } a - \frac{b^2}{a} = AC - SL.$$

With centre B and radius AC describe an arc cutting AC in S. Then S is the focus. Take CH = CS and through S draw SG ∥ AH.

$$\text{Then, } \frac{CG}{CS} = \frac{CH}{CA} = \frac{CS}{CA} \text{ or } CG = \frac{CS^2}{CA} = r.$$

Draw the lines $a\,a$, $b\,b$, $c\,c$, $d\,d$, each equal in length to r or C G, and describe the curve Q p R, so as to touch each of these lines. If in equation (2) and (3) we make X = CM = x, we must have

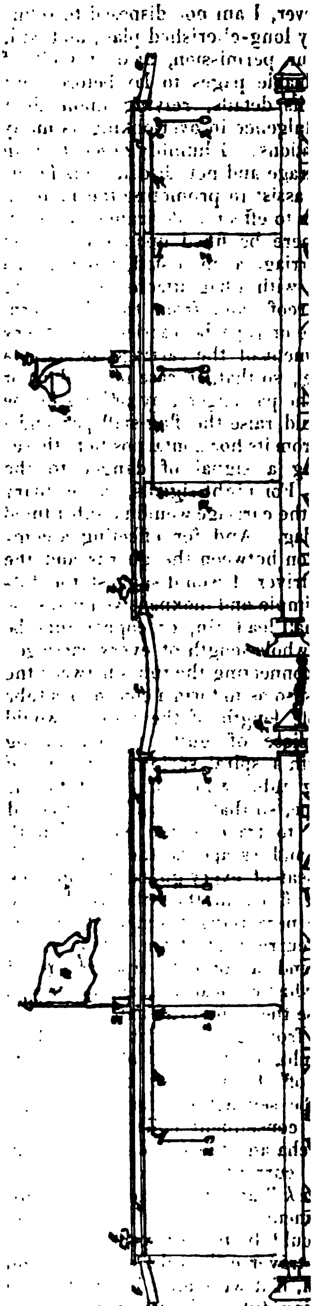
$$\frac{b}{a}\gamma = y = Mp, \text{ or } MP = \gamma = \frac{a}{b}Mp.$$

Any additional number of points may be found in the evolute by giving any other value to X and x than CM. When a sufficient number have been found the evolute Q P T may be struck, so as to pass through them, and be a tangent to the axes of x and y at Q and T. With ordinary care the result will be as accurate as if independent calculations had been made from the equation to the curve for every point actually taken.

F. BASHFORTH.

RAILWAY SIGNALS.

Sir,—I had the honour in the early part of June to submit to the public, through the medium of your valuable publication, a plan for effecting communication between vessels at sea, &c., and between passengers, guards, and engine-drivers upon railways. I did not at that time enter into the details of my plan to the extent I should have wished, and was prepared to do; subsequently however I addressed myself to the Commissioners of Railways, with a full description of my plans, but was informed that they had no power to interfere, and advised an application on my part to some railway company. I made an application at the time to the chairman of a railway company, but, I am sorry to say, without experiencing much encouragement. I merely state these facts in consequence of a claim made by the editor of a Sunday paper to the merit of having first suggested one of the leading features of my plan.



ever, I am not disposed to relin-
ay long-cherished plan, and will,
our permission, avail myself of
uable pages to lay before your
its details, relying upon their
dulgence in overlooking its many
ections. I humbly beseech them
ntage and not disdain this feeble
o assist in promoting the adoption
ns to effect so desirable an object.
there be fixed upon the roof of
arriage a small staff, moving on a
, with a flag attached to the long
ereof; and from the short arm
ire or rope be carried into every
tment of the carriage, to act as a
e; so that, in case of accident or
the passengers, by pulling in the
uld raise the flag-staff perpendi-
from its horizontal position, there-
ing a signal of danger to the
For night-signals, the ordinary
f the carriage would be substituted
flag. And for effecting a com-
tion between the guards and the
driver, I would suggest the fol-
simple and inexpensive means :—
mall lead, tin, or copper tube be
whole length of every carriage;
connecting the tubes between the
es so as to form a continuous tube
ole length of the train, I would
piece of gutta percha tubing
ith a spiral spring. One end of
g tube would be fixed to the
pe, so that a jet of steam could
le to traverse the whole length
and escape at the distant end.
seat of every guard a stop-cock
e fixed in the tube, so that he
n perceiving a signal of danger,
current of steam, which would
cend a branch pipe furnished
whistle, near the engine-driver,
se the same to sound, or remove
from a bell machinery. This
ould, in the case of a carriage
off the rails, or becoming de-
be self-acting; for the elonga-
d consequent collapsing of the
cha and the spiral spring, would
e current as effectually as the
ock," and cause the same result.
ements in connection with the
could be made to cause a current
o traverse the tube in substitution
m. If it were more desirable—the
ting tubes of gutta percha, &c.,
e instantly attached and detached
adoption of slides, &c.

Giving false signals could be rendered by a by-law a misdemeanor, &c.; such cases I am inclined to believe would be few and far between; and as this is one of the principal objections to the introduction of the means of communication upon railway trains, I beg to refer those men of *evil thought* to the falsity of their predictions as to the security from mischievous acts of the suspended wires of the Electric Telegraph, which have hitherto remained unmolested. Let the experiment be tried, and the result will justify them in commending or traducing the national character;—and not till then. You will be ready to say, Sir, that my letter partakes of the elasticity of my gutta percha tube, and like it, when overdrawn, I must stop the steam and give way.

I remain, Sir, yours, &c.,

OWEN ROWLAND.

11, Heathcote-street, Mecklenburgh-square,
September 20, 1847.

Description of Engravings.

a Day signal of danger.
b Night signal do.
c The gutta percha connecting tubes.
d The fixed tubing along the carriages.
e The stop-cocks.
f The convex buffer.
g The concave do.
1 1 Flag and lamp staffs.
2 2, &c. Handles.
3 The fulcrum of the staff.
4 The strings or wires for raising the signals.

ON THE MILL-GRINDING AND HYDRAULIC PRESSURE PROCESSES OF EXTRACTING SUGAR FROM THE CANES. BY HENRY CROSLEY, ESQ., C. E.*

The operation of extracting or squeezing out the juice of the sugar cane (but *a part only*) is universally accomplished by vertical and horizontal sugar mills, generally of three rollers, of diameter and length varying according to the opinion of the proprietor of the estate, or his representative. In some colonies a mill with four vertically-placed rollers is used, and preferred to the horizontal mill of three rollers; as by the former the canes are *thrice nipped* or squeezed, in

* From "A Treatise on the Manufacture of Sugar, Presented to the Royal Agricultural Society of Jamaica, June 1844." Also, "Observations on Recent Improvements, &c." By Henry Crosley (H. Crosley and Co.), engineers, Emerson-street, Southwark.

lieu of *twice*, by the latter; and those persons who use the mill of four rollers consider that they obtain, by the *extra* nip, a proportionately increased quantity of juice; while those who use the horizontal rollers closely set, assert that they obtain more juice in consequence of the horizontal mill being fed more equally, and also worked with the same or less motive power than that required for the vertical mill of four rollers. But without descanting on the merits of either of these mills, it is unanimously agreed, that, with the best constructed sugar mill, worked to the extent of its capability, some portion of the cane juice still remains in the megass; and hence, to obtain the residue, improvements (as they are termed) have been made in constructing sugar mills with five, six, and even seven rollers; the latter by an eminent French engineer, but abandoned by him in consequence of the increased cost and great power required to work such a mill; which must be evident, because, *in proportion to the surface of the rollers* acting upon the canes, the *friction will be increased*, and therefore *extra power* would be required to work this mill. The extraction of the *whole* of the juice has been objected to by some persons, who consider that by so doing the megass would be useless for fuel—and none is equal to it for the battery of sugar pans as they are now generally fixed and worked; and if it can be proved that SUGAR is of *less value* than COAL (which, although not suitable for the old battery of fire pans, it is available for steam pans), then the advocates for a *moderate squeezing* of the cane are right. But a little reflection should convince them that their opinion is erroneous. The object of the planter is generally to grind canes as quickly as possible; and recently a Mr. John Biggs, civil engineer, of Jamaica, has advocated and recommended, in a pamphlet published by him in England, that the speed of the rollers of the sugar mill should be increased from four to seven and a half revolutions per minute; and he states, in page 14, that with six instead of four, he had obtained the extra quantity of 200 gallons of juice per hour, which of course must be from the *extra quantity of canes* passed through the rollers during that period; and it will be found by calculation, that the quantity of juice obtained from the *extra* quantity of canes passed through the rollers, was increased in, about the proportion of 4 to 6, the speed of the rollers; therefore the supposed advantage was an illusion. The object is, and must be, *to obtain the greatest quantity of juice from a given quantity of canes*, and *not to pass them through the mill regardless of quantity*. It is needful to obtain [illegible] quantity of juice within a limited [illegible] but this must not be effected by the [illegible] of canes, which yield juice propor[illegible] less when they are passed through th[illegible] at a *quicker speed*; therefore, in the [illegible] ment of Mr. Biggs, although he ob[illegible] greater quantity of juice within th[illegible] named, still, had he passed the canes [illegible] the rollers at a *slower speed*, he wo[illegible] obtained more juice than the quanti[illegible] obtain, because, the *nipping powe[illegible] rollers* would have dwelt *longer* u[illegible] canes. The *proper speed* of a sug[illegible] *not to be determined by the revol[illegible] the rollers* on *their gudgeons*, but [illegible] *speed of the peripheries of the roll[illegible]* gineers and other persons, acquain[illegible] the milling of sugar canes, conside[illegible] feet per minute is the proper speed; [illegible] operations in the boiling-house oug[illegible] the guide as to the working of th[illegible] mill, as any excess of juice not imm[illegible] operated upon becomes deteriorat[illegible] hence arise considerable drawback[illegible] after operations. The speed of 25 fe[illegible] of the peripheries of the rollers pe[illegible] *is wrong in principle*, be the qu[illegible] juice obtained what it may. The [illegible] of advantages of the sugar mill oug[illegible] estimated by the *weight of canes*, a[illegible] *the bulk*; because, as has been pr[illegible] experiments made in Cuba—

100 lbs. of canes passed betwee[illegible] rotating ten times per minut[illegible] 50 lbs weight of juice;

and by the experiment immediatel[illegible] ing—

100 lbs. of the same sort of ca[illegible] the same mill, the rollers rotat[illegible] three revolutions per minute, [illegible] 74 lbs. weight of juice.

Consequently, it must be admitted [illegible] present mode of squeezing the ju[illegible] the cane, by the best mills, and at the [illegible] considered proper speed, is a defec[illegible] thod.

And again, this is corroborated by [illegible] ment of an analyzation made by an [illegible] French chemist, who ascertained [illegible] sugar cane ripe, and in good conditi[illegible] tains 90 per cent. of liquid matter [illegible] and only 10 per cent. of solid or [illegible] therefore, if 50 to 60 per cent. of [illegible] extracted (as is supposed) by the h[illegible] mill, worked at the usual and suppo[illegible] per speed, there must remain in the [illegible] even by the most advantageous w[illegible] from 30 to 35 per cent. of liquid [illegible] But there are other cogent reason[illegible] lieving that the juice remaining in the [illegible] is richer in saccharine matter than t[illegible] expressed from the cane, and this [illegible]

. upon the assertion of a scientific
an many years a resident in Cuba,
on dissecting, as he did, a ripe cane
from the field, discovered with a
ope small crystalline deposits in the
the fibres; therefore it is reasonable
me, that the richest or solid por-
the saccharine matter remains in the
and from these data may have
he recent invention (noticed by the
f the *Kingston Morning Journal* of
of January last) of the application
ostatic pressure as a substitute for
r mill; and as the writer has ob-
he results of experiments made in
ent during the last crop, and also
cently made in England, upon sugar
e states them in corroboration of the
g remark as to the present inefficient
of squeezing the canes by a sugar-

ly, In St. Vincent, with an hydrau-
s of 1000 tons power (worked by
mps), presenting a surface of 25
feet on the follower, or table, on
e canes were laid, they were only
squeezed, in consequence of the
d pumps not being suitably con-
, and the manipulations improperly
ed. The juice which flowed from
s, when compared with that from
r mill, was as fine-conditioned pale
ine is to muddy water, and the ex-
juice did not ferment so quickly as
juice; but it was found that a por-
the juice remained enclosed in the
f the mass of canes, which were not
so effectually as they would have
l those causes not existed.

., a certain quantity of canes were
through the mill, the rollers being
osely, that the megass was torn into
eces, and the produce was 94 gallons
. The megass was then subjected
ulic pressure, and 10 gallons of
ained from it.

dly, In England, in February last,
nes were subjected to a better con-
and more powerful press, of 1400
er, worked by four pumps, the sur-
the follower 14 square feet, and the
anes nearly twice the height of the
rated upon in St. Vincent, and in
ut the same. By this last experi-
e follower or table of the press was
feet in eight minutes, by the power
n at the double-ended lever handles
pumps; but it is considered, that
nual labour is scarce, they could be
y two mules, or by a small steam-
f two horse power. It therefore
that, by the first experiments in St.
although the canes were greatly reduced in bulk, yet in the centre of the mass some portion of the juice remained; but by the last experiment in England, this disadvantage was surmounted by placing horizontally amongst the canes six strong iron pipes of 1 inch bore, the surfaces perforated with holes, by which means the pent-up juice escaped from the centre of the mass, and the WHOLE was discharged from the canes, which, as it is said, were perfectly dry. The megass had the appearance of a solid block of wood; and upon trying pieces of it in a vice, not one drop of juice could be extracted. Therefore it is reasonable to presume that this improvement will supersede the use of sugar mills, the rollers of which only give the canes an instantaneous nipping SQUEEZE at the point or surface of curvature of the rollers; whereas, with hydrostatic power, the PRESSURE is insistent in one line of direction, whereby the canes are riven lengthwise with the fibre; and as the nipping squeeze of rollers discharges the resinous substance in the rind of the sugar cane, which commingles with the juice when heat acts upon it, the quality of the sugar is thereby additionally injured; but, if the hydraulic press is employed, the resinous matter would not operate detrimentally, or, as it is supposed, not to the same extent.

Such are the methods now used and proposed for expressing the juice from the sugar cane. Other and perhaps less efficient means might be employed, but as those have been only partially tested in principle upon other substances, and not upon sugar canes, and as they are in a great measure the eductions of the writer's mind, he refrains from detailing them, considering that the pressing system, from its simplicity and efficacy, must eventually command a preference.

Note.

The application of hydraulic presses as substitutes for the sugar-cane mill, has been previously expatiated upon, and as such *supposed* improved method has not been adopted, it is necessary to explain why, and to state the causes that led to the promulgation of that method, as stated in pages 4 and 5:

In February 1839, in my pamphlet—"Suggestions" (which I gratuitously presented to the West India Proprietary), at pages 18 and 19 I alluded to the inefficiency of hydraulic pressure for discharging the juice from rasped beet root, and by inference concluded that that pressure would not be applicable to expressing the juice from the sugar-cane; nevertheless, in March, 1844, it was reported to me by the parties especially interested in the method for substituting

hydraulic presses for the cane mill, that by an experiment reported to them by the projector of the new method, that he and the person charged with the construction of two hydraulic presses of the supposed power contracted for, viz., each 1400 tons, subsequently sent to St. Vincent, that upon trial with sugar-canes purposely imported, the juice had been wholly discharged, and that the mass of expressed canes were as dry as a block of wood. The trials made in St. Vincent with these presses upon canes just cut, did not yield such result; and, moreover, it has since been ascertained, that the said hydraulic presses were each of them of the power of 600 to 700 tons only; and, consequently, the report of the trial made in this country on the stale sugar-canes must have been erroneous. It was upon the faith of such report being correct, *(although doubted by me,)* that I was induced to make the remarks upon hydraulic pressure, as stated in the preceding pages of this treatise; but even supposing, and admitting, that the juice in the cane could be discharged by hydraulic presses, *many would be required*, and THE POWER EXPENDED TO WORK THEM WOULD BE PRECISELY THE SAME POWER NECESSARY TO WORK A CANE MILL, TO YIELD THE SAME QUANTITY OF JUICE. The slow motion of the hydraulic press could only be compensated for by employing many; and, as speed is only to be obtained at the expense of power, it follows, as a matter of course, according to mechanical principles, that were hydraulic pressure adopted in lieu of the sugar mill (which would be far less costly than presses), to obtain a given quantity of juice in a given period, the *same amount of power must be expended to work the presses* as would be necessary to drive the mill, and with the additional disadvantage that much more labour would be required for pressing.

In the body of this treatise, the operation of grinding the sugar-canes, and thereby squeezing out the juice, by the common and disadvantageous method used of driving the rollers of the mill at an improper speed, is descanted upon, and a statement given of the quantity of juice obtained from 100 lbs. weight of canes, passed between the rollers of a mill rotating at three and at ten times per minute; and that by the quickest rotation 50 lbs. weight of juice was the product, while 74 lbs. was obtained by the slowest rotation. The rotation of the rollers, which vary in diameter according to the size of the mill and the power to work it, ought *not* to be the criterion, but the proper *number of feet of surface the peripheries of the rollers rotate per minute* ought to guide the operation of grinding the canes; and [illegible] slow rotation may not appear [illegible] cial, as dispatch is a desirable obj[illegible] the ON-DWELLING of [illegible] thereby obtained, would amply [illegible] as the product of juice would be [illegible] proportionately to what [illegible] the peripheries of the rollers [illegible] *usually quick and* [illegible] *quantity of* CANES ground in a gi[illegible] *ought not to be the* [illegible] contrary, the *greatest quantity* [illegible] from a given quantity of sugar-can[illegible] ought to be, the object; but by th[illegible] mode of working the mill, rarely [illegible] the saccharine matter out of 18 (w[illegible] canes contain) is obtained; [illegible] quently, if the whole were extract[illegible] *can be*, by improved means, the [illegible] of canes would yield a proportiona[illegible] of products to those now obtaine[illegible] common method.

The advantages of an ENDURING PRES[illegible] SURE on the canes when passing the rollers of the horizontal mil[illegible] rollers are preferable to those pla[illegible] cally, as the feeding of the former [illegible] form, and not so the latter; but [illegible] such uniformity the canes get only [illegible] squeeze at the point of contact [illegible] the top and bottom rollers; [illegible] lieu of so milling the canes, it w[illegible] great advantage to subject them [illegible] DURING pressure, and not to nip [illegible] them momentarily only, as is now [illegible] This manifest advantage led [illegible] sugar-cane mills of one roller [illegible] two, and especially to the improv[illegible] of rotating the periphery of the [illegible] the mill, now generally used, at [illegible] velocity to that of the bottom rolle[illegible] such dissimilar speed of rotation, [illegible] in a longitudinal direction, are [illegible] a PRESSING, RUBBING, and [illegible] POWER, and not merely to a [illegible] nipping squeeze.

In order to secure the benefits [illegible] arise from supplying such power to [illegible] ing the juice from the sugar-cane, [illegible] improvements hereinafter stated, I [illegible] a patent in April, 1845, for improv[illegible] cane mills, of an entirely new con[illegible] and also for fixing upon the [illegible] axles of the rollers of sugar mills [illegible] are in general use, pinions of [illegible] diameters, whereby the advantages [illegible] can be obtained. One set of such [illegible] have been tried in the West Indies, [illegible] engineer's report is, that "the [illegible] pressed canes were as dry as straw." [illegible] has also been sent to the East In[illegible] another set has been recently [illegible] mill about being erected in this [illegible]

...ndes and it is anticipated that ...ose will be generally adopted, as ...e is trifling, and because they can ...d fixed to any mill now in use. ...be remarked, and justly so, that a ...power than that now employed for ...a mill with pinions of equal dia... ...uld be necessary, but it would be ...the rotation of the rollers is as ...they are usually worked. The ...ower employed, whether that of a ...gine, water-wheel, windmill, or cat... ...d, suffice without addition thereto; ...slower speed, would compensate ...tra power that might be necessary ...ing the rollers with pinions of dis... ...diameters, or mills with rollers of ...diameters, and with pinions of ...diameters, would produce the like ...d the result would be an increased ...f juice from a given weight of proportionate to the ENDURING ...of the rollers.

ADCOCK'S SPRAY-PUMP.

...have observed for a long period ...ous reports made in reference to ...trials of Adcock's patent spray ...the prosecution of which, I must ...within bounds when I say, above ...and pounds have been expended, ...several demonstrations made with ...pool, Wigan, Tipton, and Llan...

...igan, in Lancashire, it was erected, ...ty belonging to Mr. Daglish, a well... engineer and large coal proprietor. ...eriments made there were very nu... consuming considerable labour, ...outlay of capital. Great expecta... entertained throughout the neigh... ...for two or three years; abandoned ...to be recovered by a blast of air ...zinc pipes, instead of employing ...nd pump-rods, with buckets, clacks, ...and heavy pipes of cast iron— ...*Mag.*, September 11, p. 41.) Yet, ...it may appear, the whole under... ...as abandoned, and the old method ...ing resumed.

...hear of Mr. Adcock at Tipton, ...mingham, with a mine, over which ...rietor gives him complete control. ...adopts a large blast cylinder, con... ...his previous failures entirely attri... ...employing the revolving blower. ...ons of the working of the spray ...ke place; all is pronounced by the ...to be satisfactory, and yet we shortly ...ar that the spray pump is lying ...in an adjoining field, awaiting its ...Wales!

Mr. Adcock is now, and has been many months at Llanhiddel, at the collieries of Reginald Blewitt, Esq., member for Monmouthshire. The exhibitions there have been numerous. At one trial of the patent pump, we learn that Messrs. Harley, Williams, Pleviek, Powell, Protheroe, Russell, Latch, and Dowling, with others, were present. There is, therefore, no secrecy (or need be none) about Mr. Adcock's operations; nor can I see that there is any particular occasion to withold from the scientific world every and the fullest information respecting an invention, which is decidedly either one of the very best, or one of the very worst and most deceitful of the present day.

It is in reference to this latest remove of Mr. Adcock that your correspondent "Cassell Morlais" writes in your number for 11th Sept. His letter appears to me to be written in a very fair, honest spirit; so much so, that I never doubted it would elicit from Mr. Adcock an unreserved reply. But how was I disappointed when your magazine for last Saturday came to hand? Till now, I had always supposed Mr. Adcock to be incapable of such flirtation as his letter displays, particularly in a matter of equal consequence to himself and the best interests of an important body like our mine owners. He asks your correspondent for his real name and address only, with the flippant assurance that then—"I may *probably* deem it worth my while to reply to him." His "public exhibitions" of the spray pump at Llanhiddel, he says, are "matters so important, it cannot be supposed that I can find time to reply to every anonymous correspondent who, *assassin-like, stabs in the dark!*" First, no one but Mr. Adcock can trace the *assassin* in Morlais's letter; and, secondly, he might have replied to this first anonymous correspondent so far as to give what he considers the unperverted facts, and then declare his requirement of names to any future correspondence. How much more likely would this sensible and natural course of conduct be to operate in his favour, than his rushing into the arena afforded by your excellent magazine, only to declaim about assassins, stabs, poison, malice, and such mere nonsense, addressed to your readers on the one hand, while on the other, he retires bowing significantly to his Welsh customers, with an assurance that the letter in question is "an insult to the understandings of these scientific and practical men who have seen the operations of the spray pump, and *have given orders.*" It is, assuredly, very ridiculous, not to say contemptible, for Mr. Adcock to write in this querulous strain, when, in fewer words than he has thus fruit-

lessly employed, he could have given the best refutation of "wilfully and wickedly perverted facts," by opposing to these a few of his own facts and figures, and which, indeed, he is bound to do; for he may rest assured, until he does this, it will, after six years' experimenting, reasonably appear that there is still some screw loose.

I am, Sir, yours, &c.,

J. PHILLIPS.

Nelson-street, Greenwich,
Sept. 20, 1847.

[We recommend the preceding very sensible letter to Mr. Adcock's serious attention. Reasonable doubts, founded on given data, are not to be disposed of by mere angry words. Nor does it matter anything in such a case by whom the doubts are started—whether by some plain "John Smith," who gives you both his name and address, or some "Tim Shellis," who, delighting in anagram and bush-fighting, leaves you to guess who he is. The game is started anyhow, and it were wiser to run it down as fast as you can, than to insist on first knowing "who started the hare." "Cassell Morlais" may have made mistatements—more probably mistakes; but if he has, there will be more to be gained by refuting than reviling him. ED. M. M.]

THE "CRICKET" STEAM-BOAT EXPLOSION.

The consequences of this explosion, (of which we gave a brief notice on the day of its occurrence,) were fortunately much less disastrous than at first reported. Only five persons appear to have lost their lives; and though no correct return of the wounded has been obtained, there is a prevailing impression that the number has been inconsiderable. A coroner's inquest has been held on the bodies of the persons killed, which, after repeated adjournments, and the production of a large mass of evidence on the subject, is, at the time of our now writing this, assembled to consider their verdict. The only portion of the evidence which seems to us of engineering interest, is that of Mr. Lloyd, the chief engineer and inspector of machinery of the royal navy, who was appointed by government to inquire into the cause of the accident; and that we shall give at length:—

Mr. Lloyd.—I have examined the machinery of the *Cricket* steam-boat. I have had a few drawings made by way of illustration, and I now produce, for the information of the jury, a plan of the vessel when I first saw her after the accident; a plan of the boiler, a drawing of the safety-valve with the weight, a drawing of the spring-balance with its safety-valve, and a drawing of the front of the boilers, as they originally appeared. I also produce some specimens of the *Cricket* boiler, the material of which has been cut into slips and tested. The engines are high-pressure engines, on the principle well-known by the name of Wolff's. There are two cylinders to each engine; one cy which the steam is used at high-pressu where, instead of passing into the open does in an ordinary high-pressure engine, into the second and larger cylinder, from passes into the condenser, where it is con the ordinary way. The object of this arra is, of course, the saving of steam, and, the fuel. So far as I saw, the materials and w ship of the engines were good. As comp high-pressure engines of the ordinary con I should say there is nothing objectionab principle of these engines in point of dang were attached to the engine two pumps f the boilers, another pump, worked by an engine, which is commonly called "the and a fourth pump, to be worked by hand ing the boilers also. These pumps appea that is necessary. With regard to the boi were two, consisting of an external cylin in diameter, having an hemispherical e back, and a front composed of a flat plate. flat plate are fixed a cylinder forming the and all the small tubes through which the of combustion pass. The internal part of t consisting of the furnace, the firebox, small tubes, was secured to the shell by ing round the circumference of the front by two stays, one fixed between the end o box, and the end of the boiler, and the o fixed obliquely between the top of the fro upper part of the shell. There was a ste also rivetted to the top of each boiler, an dome there were two safety valves pressed levers: one lever having a weight at its the other being a spring-balance—Salter's The thickness of the tube-plate was three of an inch; of the front plates—that is, t on the top and bottom of the tube-pla eighths of an inch, and of the shell three- an inch. I ought to have said that the fr boiler consisted of three plates; the centr tube-plate) was three-quarters of an inch t the top and bottom plates, or shell, we eighths of an inch thick The dome-pla sixteenths of an inch in thickness. The a round the front of the boiler was three half an inch. All the other angle iron is half inches by three-eighths of an inch. in the boilers are three quarters of an diameter, and those in the steam-dom smaller. All the rivets of any import three-quarters of an inch in diameter. each boiler to be of 16-horse power, the tot surface in the boiler is 14 eight-tenths sq per horse power. The area of the fire 55-100ths of a foot per horse power. T nothing objectionable in these proportio amount of area of fire-grate and heatin The quantity of water in the boiler up to t gauge-cock, is about 3 8-10ths of a cubic horse power, and the steam-room about 1 horse power. I have calculated the pres the safety-valves, supposing the weight to extremity of the lever, at very nearly 66l square inch. Taking the spring-balance when I saw it, the pressure per square in the valve was just about to open, would be square inch; but, if the valves were wide spring-balance would produce a pressure 170lb. per square inch. The valves are b valves; but one is pulled down by th balance, and the other is pulled down by th As the lever rises, the pressure is gradually upon the spring-valve. I may mention th the spring-balance produces a pressure on of nearly 2lb. The weight and spring valv jointly on the boiler, but separately as reg other. I apprehend that if all these va been properly in operation, the steam have accumulated in the boiler to any d extent. I do not approve of the arrangem spring-balance valve. I think it objectio

ıen the valve has been raised such a dis- o relieve the boiler materially, the pressure ıpon it is very much increased, the power er being nearly as 10 to 1. This is not the ' in which spring balances are used, as far '. I cannot say the spring valves would o be easily disordered. I think it is wrong le to put a spring balance at the end of a r, because the pressure is increased very bly as it is raised from its seat. I object r to valves being in the power of the to load as he pleases, especially in the igh-pressure engines. As to the weight think, if it were not intended to work ers at the pressure of 66lb. to the square ı a weight as was on the levers ought not ɪeen put upon them. The same remark) the spring balance, because it can be lown to any pressure the engineer might From the spring valve being on the should draw the inference that it was the engineer should use it if he thought ı regard to the construction of the boiler, r, that in my opinion, it is dangerous to be high-pressure boiler. The whole of the of the steam within the boiler is brought ectly or indirectly upon the flat plate in . I find, when the pressure of steam is 66lb. square inch, the direct pressure upon this 3 tons. This pressure is withstood entirely iffness of the plate itself, with the small of the two stays I have before mentioned. ; believe that a pressure of 66lb. on the ch would have burst this boiler at present; ık, when the boiler was somewhat older, it ıve done. I may mention, perhaps, the s which naturally lie against a flat plate of l. In the first place, you cannot calculate ssure it ought to bear; and the pressure inside of it tends to produce three different There is a strain brought upon it at right the surface, and if the plate was perfectly :e would be no other effect; but, the plate ; rigid, an enormous pressure is brought ı its own plane. This second action may illustrated by considering the pressure ıpon a musical string by pressing it side- here is a third action upon the plate pro- ' the bending of the plate, the outer cir- ce of the plate remaining nearly in the ıe, and the inner part being considerably I have come to the conclusion, from the nination I can give to the subject, that gth of this front plate, aided by the two erfect stays that were put in the boiler, sufficient to bear for a length of time,— during the usual time a boiler may be to last,—a pressure of steam of 60lb. square inch. At the present time, un- ıbly, it would bear that pressure. Sup- l the valves were prevented from acting, ressure was 60lb., I calculate that in five the pressure would increase to 90lb.; in tes it would be from 130lb. to 140lb.; and :er of an hour it would rise to about 180lb. conceive it probable that all the four valves ck at the same time. I do not think, if was at liberty, that it would relieve the team as fast as it was generated, supposing ' three valves were fast. If two valves berty, they ought to relieve the boiler suf- I may observe, that the area of the steam early five square inches. but the area of the ım-pipe, which takes the steam into the only two seven-tenths square inches. I he two weight valves were tied, and the g valves were free, a dangerous pressure produced upon the boiler. After having :xamination of the boiler, I thought it was test the goodness of the materials, and I :s of the plates of the boiler which were ı it burst. These plates are three-eighths h thick. I cut strips of two inches in width from them, both with and against the grain, and tore them asunder by a machine for that purpose at Woolwich. I now produce four strips of the boiler-plate. In order to make a comparison as to their goodness, I had four slips cut from a new plate of the same thickness, and subjected to similar tests. The average strength, the tensile strength, per square inch of the plates of the *Cricket* boiler was 17 tons; and the strength of the best kind of plate of the same thickness which I tried at the same time was 21 2-3 tons. The new plates I tried were Low Moor plates. They are of very far superior quality to the plates of the *Cricket*. The plates of the *Cricket* boiler are laminated. I attribute that to bad quality. It will happen, undoubtedly, in plates of the best quality, but it is a thing very much to be avoided. When I say the iron of which the *Cricket* boilers were made was bad iron, I should rather say that it was bad iron, considering the purpose to which it was applied—to a high pressure engine, and considering also where it was applied—to the front of the boiler, where it was most likely to break. I tried some common Staffordshire plate at Woolwich, which was nearly equal in strength to that of the *Cricket*; it bore 16 2-3 tons upon an average, which was low. I do not consider the workmanship of the boiler to be such as it ought to have been for a boiler of this kind. The rivets, generally, did not fill the holes, and they were generally not sufficiently long to make a good rivet. The boiler does not appear to be seriously deteriorated by wear, except at the lower part. I should not attribute the explosion to the wear of the boiler. The part which exploded was in the front; the whole of the front was torn off. The boiler was, of course, weaker than when it was new, but not materially. There is no calculation by which we can tell what pressure the front plate ought to have borne. I applied tests to ascertain the quality of the iron, and I come to the conclusion that the iron was not of very good quality, considering the purpose to which it was applied. Such iron is used in the royal navy commonly for those parts of the boiler upon which there is no great strain. Where the plate was thinnest, there the plate tore; and where it was thicker, the part to which it was fastened gave way. With the consent of Mr. Smith and Mr. Joyce, who afforded me every facility during the inquiry, I made an experiment on the unexploded boiler. I brought upon it a pressure of water of 136lb. per square inch before it exploded. The boiler we tried was sensibly injured by the explosion; the plates of both were of the same thickness. Both the stays of the unexploded boiler were separated, and a part of the angle iron which secures the front to the shell of the boiler was cracked. Upon this boiler I brought a pressure of water of 136lb. per square inch, and then the boiler leaked to so great an extent, that a greater pressure could not be obtained. My opinion is, that the pressure of steam which caused the explosion could not have been less than 136lb. upon the square inch. That, of course, is matter of opinion; but I have come to that conclusion. I think the other boiler could not have exploded at a less pressure than that—but it is a mere guess. You can calculate perfectly what the shell of the boiler ought to bear. I have no reason to suppose from the examination I made that there was any deficiency of water in the boiler. I do not think there is any reason to suppose that. The boiler is called tubular, from the circumstance of a number of tubes being introduced, to absorb the heat. We regard the tubular boilers as safe boilers. I think they are safe, if properly made. The tubes of the exploded boiler were perfectly good. The great objection I have to the boiler is—firstly, the form of the flat front of the boiler without proper staying; and, secondly, in a far less degree, the quality of the material and the workmanship.

The Coroner.—Can you form an opinion as to the cause of the explosion?

Witness.—There can be no doubt of the cause of

the explosion, namely, the improper increase in the pressure of the steam shortly before and at the time of the explosion. If the steam gradually increased its pressure from 60 lb. to 130 lb. or 150 lb. in the space of 10 minutes, or in any other time, that would probably be sufficient to cause an explosion. That the unexploded boiler had evidently never been subjected to a similar pressure as at the time of the explosion, is apparent from the fact of its leaking very considerably at the pressure to which it had been subjected on the day of the explosion. There is a connexion between the water part of the boiler and the steam part of the boiler. The pressure would be the same on both boilers at the same time, that is, if only one valve had been in operation. In order to show the great pressure upon the unexploded boiler, I may state that the flat plate on the front of the boiler was permanently bulged to the extent of 1¾ inches before I made my experiments. After it had been subjected to the water pressure of 136 lb., the bulging was 2 1-16 inches; the lower front plate of the boiler then began to break exactly like the one which was broken in the exploded boiler. If all four of the valves had been at liberty, it was impossible for the steam to have caused the explosion. If both the spring valves had been at liberty, the explosion could hardly have taken place; at all events, the time would have been postponed, perhaps 10 minutes. I have every reason to believe that the valves must have been closed, either by accident or design, at the time of the explosion, or else open to a very small extent. The stays were no doubt the first to go when the plate began to bulge. The inside of the boiler struck against the engines, which stopped its further progress; that saved all the people in the front of the vessel. The shell of the boiler went through the after part of the vessel, and went out at the stern. When you consider that the pressure upon the boiler might have been 180 tons, and assuming the shell to have weighed a ton and a half, you get a force of more than 100 times the force of gravity, which accounts for the velocity given to a mass of iron in such a wonderfully short space of time. I did not see the balance valves of the exploded boiler. The balance of the unexploded boiler was correct.

By Mr. Chambers.—The object of the spring to the valve is not to prevent its opening too widely, that ever I heard of, but merely as a substitute for the weight in a more convenient form. I do not disapprove of spring valves, but only of the manner and place in which they were used. I object to their being used in such a way that, as in the case before us, 1lb. on the lever would produce a pressure of 2lb. upon the boiler. Mr. Salter's spring balances are very excellent things. I object to the engineer having the control over the valves at all. You can always raise a valve in a well-constructed boiler, but not pull it down. The engineers in the Royal Navy have not access to the valves: in locomotives the engineers have access to the safety valves. I found the spring of the unexploded boiler correct; as nearly as can be calculated, it was about 40lb. per square inch when the valve was shut, but as the valve opened the pressure increased. For anything I can tell, the safety valve was not permitted to rise in the unexploded boiler. If both the Salter's balance valves had been in a fit state, a longer time would have been necessary to get up the steam to the bursting pressure. I cannot tell whether they would have opened sufficiently to let out the steam of themselves; I doubt very much whether they would. The waste pipe of the *Cricket* is small, and is a bent pipe, and all that impedes the passage of the steam into the chimney, but to what extent it is impossible to say. The noise would have been very great if any of the valves had been acting, and the steam had been 5lb. above 40 degrees. Every one who was near the funnel must have heard the steam going out of the funnel. I should have preferred two more weighted valves to these spring balance ones, certainly. The mercury gauge is the guide to the engineer as to the pressure

of steam; it is liable to get out of order
water or air gets in. There are no other
the engineer, except the guage and the safet
The pressure upon the front plate of the un
boiler was a gradual pressure; it began t
120lb. and then leaked a great deal. I d
how the pressure of steam could be brough
so suddenly as to give any force of "impact
were two stays to the unexploded boiler;
been separated. Either sudden or gradual
would have accounted for that separati
stays themselves were strong enough; it
fastenings that had given way. If the va
closed at 60°, the pressure would in five
have got up to 90°. I did not make the exp
I should have been sorry to do so. I know
tity of water which a boiler of that kind wi
into steam; I know how much heat there
steam; and then I see, by experiments
other persons, what elasticity is due to that
temperature. I assume that the fires wer
briskly, and every means used for formi
as powerfully as possible. If the tubes w
order, or there was any leakage, the cr
steam would not be much affected. The tu
to be so heated as to assist in the heath
water; and if they were clogged up, stea
not be formed so rapidly as would otherw
case. If the pressure had risen as high
the exploded boiler, the steam would hav
great noise if the valve had been open.
stoker or engineer had been there under
cumstances, he ought to have drawn the
know very few engineers who underst
matters thoroughly. (A laugh.) I wish
get people who did understand them; bu
is allowed to drive an engine in the Royal
has not undergone such an examinatio
from time to time be considered necessar
that you ought to get the best men that
as engineers, and the only course to pu
increase the wages, if any difficulty aris
taining qualified men.

By Mr. James.—My opinion is, that
valves of the *Cricket* had been in operat
time of the accident, the explosion would
occurred. That opinion is fortified by the
I have heard. It is fortified by the sta
some of the witnesses that, when the
lying at the piers, no steam blew off, supp
the steam pressure was as high as has be
sented. If the steam gauge had been
the valves had then been tied down, the p
steam must have been considerably inc
think a pressure of 66lb. on the square in
not, at the time of the explosion, have
boiler of the *Cricket*. 66lb. was the maxim
sure that could be brought upon the boi
weight had been placed at the extreme e
lever, and all the valves were in operat
pressure could be reduced by moving th
towards the fulcrum. The engineer migh
fix the spring valves down to any partic
sure. I should think a man who tied
weight valves would not be very careful
of Salter's balance. High-pressure engine
invariably for locomotives; they have
spring-balances. In the dockyards so
pressure engines are used for particular p
should prefer low-pressure engines, if
suitable for those purposes. I should
boiler that exploded must have been
than the one that remains, because
sure would be alike upon both. The bo
tested did not stand a very severe test
pressure boiler. We tried it without the
stays; and it was then bulged in consequ
previous strain. The maker of a boile
allow for any weakness that may be
corrosion. I have been told the boilers we
before they were put in the *Cricket*. Mr.
everybody connected with the vessel
every facility. Low Moor iron is some
iron that can be got. It is not used

's of commercial steamers; but it ought l for high pressure boilers. I think the of steam a boiler ought to be worked at ot exceed one-tenth of its calculated supposing it to be made of the very best and workmanship. The locomotive en- k at from 80 to 100, probably. I never : exact strength of the boilers of locomo- t they are constructed in the best manner. r iron, or iron as good, ought always to be ertain parts of boilers. The highest pres- e by one of the pieces of Low Moor iron I is 22 tons and two-thirds. I have made sure boilers, for the government, of Low ; but I don't know whether the boilers of al steam-boats are made of that iron. Al- ubular boilers have flat plates in front. If lat plate, I should construct it in such a hat the stays themselves might sustain : pressure. If the valves were tied down boiler was subjected to a strain of consi- bove 66 lb., the effect would be gradually n the boiler. All the parts of the boiler resist the straining would be acted upon by nstant pressure. Assuming the fact that r had been strained in the manner repre- ome allowance ought to be made for it in the manufacturer. The dome would not d by the pressure of 136 lb., which I ap- the unexploded boiler. The vulnerable a boiler is the bad plate in front. I would rtake, at any price, to make a boiler to be with closed safety valves. I would not e to work an engine with the valves tied A laugh.) Would as soon do one thing as r. There is one stay at the back of the d another in front, inside. The pressure rst the boiler would be pressing upon the a of the boiler. The pressure on the front iler may be supposed to be borne by the , and, if the stays were removed, the front mmediately go. Supposing an engineer lly to have tied down the valves, it is im- to say to what pressure the boilers may n subjected. The greater the pressure, the boilers would be weakened. The steam om the description given of it by the wit- as a proper one, and ought to have indi- : full pressure of steam. When I saw the the *Cricket* there was no cord round them. think at the time of the explosion there re been a pressure of from 130 to 140 upon t. My reason for coming to this conclusion se the other boiler was disabled at this

. M'Intyre.—I think if all the valves had n the accident would not have occurred. ' the lever valves had been free, I don't explosion would have taken place. It was sary to have a flat front to the boiler. I ave preferred a convex plate. The valves ver boats, in which dirty water is used, liable to be clogged; but I do not think ld stick so far as to produce any dangerous It is possible that, without any design, he four valves might have stuck at the se explosion, but it is very improbable that ld have been so much clogged as to resist iderable increase of steam pressure.

Jury.—The difference in the value of the r iron for the front plate and that which for the front plate, would not have been n £2 or £3. The front plates were the bjected to the greatest pressure of the The Salter's valve does not, when raised, greater pressure upon the boiler, but only a greater pressure. The escape of steam ngine-room does not necessarily indicate valves were tied; it might have been pro- the condensers becoming too hot. If the rs had more work than they could do, the uld have come into the engine-room.

. Chambers.—Are not the boilers of the the *Bee* ten times the working strength?

Mr. Lloyd.—I cannot say; but if the fronts of those boilers are not stayed better than these, they are dangerous boilers.

Mr. M. Chambers.—I am told they are.

Mr. James.—These boilers are not ten times the calculated strength. We say, we hope they will work safely, if the valves are not tied down.

The evidence of a number of the other witnesses examined having gone to charge Clark, the engineer of the *Cricket*, with being in the habit of tying down the valves of the engine, Clark of his own accord presented himself before the inquest to be examined. His object, it is to be presumed, was to rebut that charge; with what success, let the following extracts from his evidence attest:

By Mr. James.—I never tied any of the cord that was to keep the valve in action. I never saw Knight tie the valve. I have put a fresh bit of cord on about once in three weeks. It was a sort of spun-yarn; it used to wear out with so much pulling. (A laugh.) It used to wear out close to the weight from the constant pulling. It was a three-yarn spun and a five-yarn spun-yarn. I have wound it round the nail, but it never fastened the valve down.

Mr. James.—You are upon your oath, and I ask you whether you *have not given directions to Knight to tie down those strings?* Stand forward, Knight.

Witness.—*I can't say but what I have.*

Mr. James.—Frequently?

Witness.—Not frequently, *but generally after the boat has started.*

Mr. James.—Do you swear that you have never given him directions to fasten the string whenever the captain has given the word to "Stand by?"

Witness.—I don't think I have.

Mr. James.—Will you swear you have not?

Witness (after a pause).—Yes, I will. The rope wore out once in about three weeks; it was chiefly by the arm of the lever that it was tied. I used to pull it three or four times while lying at the pier, to be sure the valve was working. Sometimes the steam blew off at 25 degrees. The steam generally blew off when we were lying off the pier; the valves were generally lifted. When the orders were given to "Stand by," we used to lift the valves. * * * I do not think it would take six inches of the rope to allow the valve to have free action. I think it would act in one inch.

Mr. James.—I ask you, in the presence of Mr. Lloyd, and other scientific gentlemen, whether it would not take six inches?

Witness.—I will not swear it would not. It sometimes had more; sometimes it was not fast at all, and sometimes it had less. I have never seen Knight fasten down the valve so that it could not act. I have almost always tried it after him. I told him to look at the valve and fasten it. I do not believe I have ever seen Edwards fasten down the valve without giving the valve room to work. I will swear that Edwards never fastened it without giving it two inches to act in. I should think that half an inch was enough.

By the Jury.—I took the cords off the levers every night. I think the valves of high-pressure engines are more liable to stick than others. Either Edwards or Buttriss might have tied the valves out of spite to me, *and I believe they did do so.* The steam was blowing off pretty strong on the morning of the explosion about eight o'clock. The steam would blow off like thunder if the valves were up an inch. The rope must have been slackened 18 inches to raise the valve an inch. I don't recollect the valve ever lifting more than an eighth of an inch.

By Mr. Chambers.—I never fastened the cord attached to the lever in any other way than by twisting it round a nail.

LIST OF ENGLISH PATENTS GRANTED FROM SEPT. 23, TO SEPT. 24, 1847.

John Dickenson, of 65, Old Bailey, stationer, for certain improvements in the manufacture of paper. September 23; six months.

Henry Newton, of Litton-hill, near Bakewell, Derby, cotton-spinner, for improvements in spinning and doubling cotton, and other fibrous substances. September 23; six months.

George Bell, Dublin, merchant, for improvements in gas tar, by means of which improvements it may be used as a substitute for oil paint, and which he intends to designate "Patent Mineral Paint." September 23; six months.

Arthur Harry Johnson, of Gresham-street, London, assayer, for improvements in refining silver lead, by effecting a saving in one of the materials used. September 23; six months.

Charles Hancock, of Brompton, Middlesex, gent., for improvements in the preparation of gutta percha, and in the application thereof alone, and in combination with other materials, to various manufacturing purposes. September 24; six months.

LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED UNDER 6 AND 7 VIC. CAP. 65.

Date of Registration.	No. in the Register.	Proprietors' Names.	Address.	Subject of Design.
Sep. 16	1198	George Chambers	Studley, Warwickshire	Needle gauge.
17	1199	Phillip Warbleton	Upper Hallam, near Sheffield	Razor blade.
,,	1200	Deane John Hoare	Greenwich	Railway telegraph and alarm.
,,	1201	James Lewis	Stamford-hill, horticultural builder	Improved Polmaise stove.
18	1202	Wiliam Wilton	King-street, Manchester	Hot water cistern for baths.
20	1203	Dawbarn and Son	Bold-street, Liverpool	Back piece of a frock or dress coat.
22	1204	John Simmons	Birmingham	Hydraulic jack.
23	1205	George Paul & Henry Fletcher	New Bond-street, Military tailors	The "Palla Gallica," or long-sided coat.

CONTENTS OF THIS NUM

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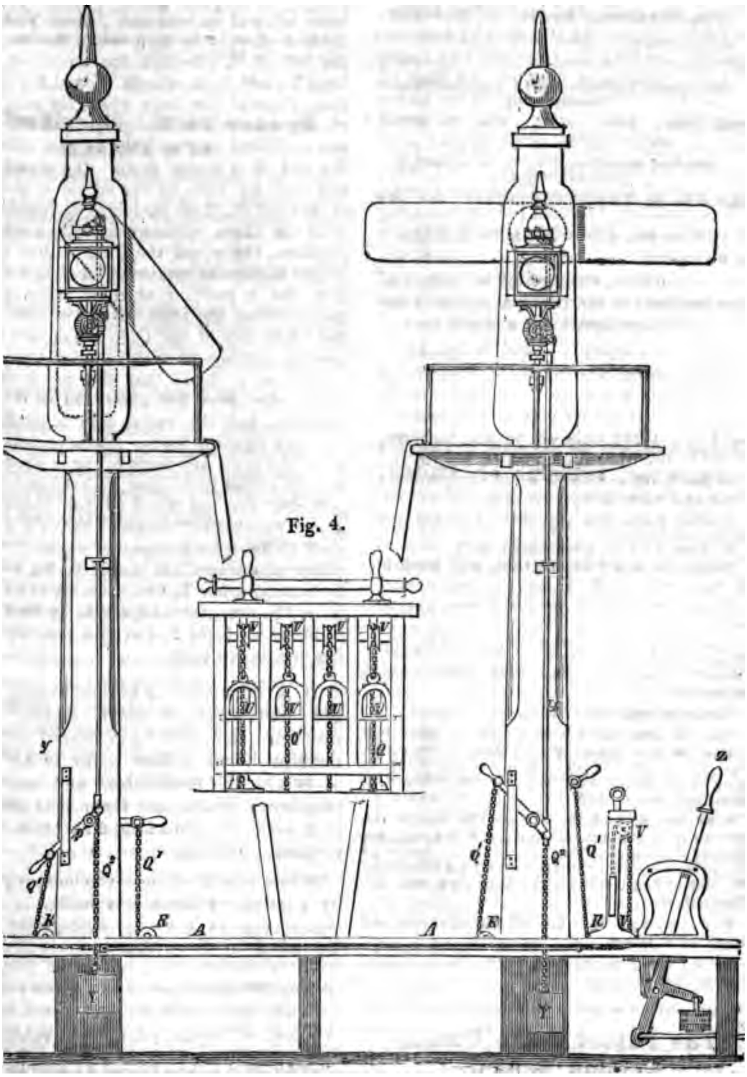
STEVENS'S PATENT RAILWAY SIGNALS.

Fig. 2. Fig. 3.



STEVENS'S PATENT RAILWAY SIGNALS.

[Patent dated March 10, 1847. Specification enrolled September 10, 1847. Patentee, Mr. Jah
of the Da ington Works, Southwark-bridge.]

The distinguishing features of this invention are, that it combines, in one apparatus or system of arrangements, the instrumentality of arms (such as those employed in the ordinary semaphore), and that of variously-coloured lamps; and combines them in such manner that both may be worked simultaneously, (or nearly so,) and by one attendant, and may serve as well by night as by day, and serve also for two lines of rails at the same time,—say an up and a down line; and farther, that in some cases the apparatus is so connected with the switches employed to turn carriages, and trains of carriages, from one line of rails to another, that the person working the signals can also work simultaneously the switches.

An apparatus, embracing so much of these improvements as are adapted to the use of a station-signal, on a single line of two railways, is represented in fig. 1.

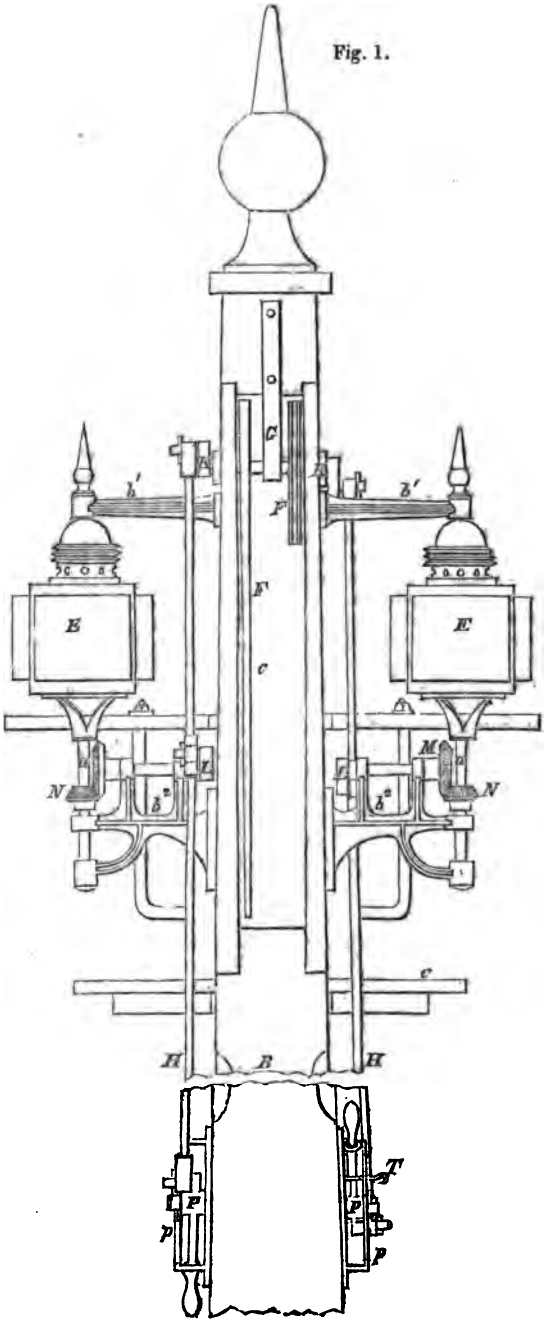
B is the signal-post which is sunk in the ground; C is a gallery to which access is obtained by the ladder; D E is a lamp of four faces, three only of which, however, are made use of, which is attached to and turns freely on a spindle *a*, which is upheld at top and bottom by two brackets b^1, b^2, projecting from the signal-post. (On the other side of the post there is a lamp of precisely the same description, and fixed in the same way.) F F are two semaphore arms, and *c* a recess in the upper part of the signal-post, into which they fall when out of sight. These arms turn on separate axes, so that they may work independently of one another, each axis having its inner bearing in a crutch G, screwed to the top of the recess and its outer bearing, in one of the sides of the recess; H is a rod passed down through the gallery, by which the lamp seen in the figure, and the arm to the left of it, are moved simultaneously (there being a similar rod to work the lamp on the other side of the post, and the arm to its left.) At top this rod is attached to a crank-lever K, fixed on the end of the axis of one of the semaphore arms, and lower down to a second crank lever L, fixed on the end of a horizontal spindle, which is supported from the bracket b^2, and carries at its outer extremity a bevil-wheel M, which works into another bevil-wheel N, on the lamp-spindle *a*. At bottom, the rod H is connected to the short arm of a hand-lever P, which is centred on a bear-

ing attached to the signal-post; a
is the case with the companion-r
other side of the post; so that on
may, without shifting his posit
both rods at the same time. S
therefore, either of the rods (H) t
down, its first effect is to raise t
tached to it, (through the medi
lever K), and its next and immed
ceeding effect is to turn round tl
the left of it, (through the med
lever L, and bevil-wheels M and
three faces of the lamp which ar
of, are coloured white, green, an
are exhibited successively in th
the rod H is drawn down: the
arms assume, also, by the action
of the rod H, three positions cor
with the three colours—namely,
position, (in which they are en
cealed within the recess *c*,) an ob
tion, and a position at right an
post. When the arms are out of
the white face of the lamp is exh
coming carriage or train, that is
garded as a signal that the wa
When the arms are shown in
position, and the green face is
that is a signal to halt or slacken
when the arms are outright, or in
at right angles to the post, and the
exhibited, that is a signal to stop,
some apprehended danger. Whe
sired to leave for a time the sign
either of the two last positions, t
by passing a pin T, which hangs
from the post, through a hole in
p, under the lever P, and into a c
ing hole in the post.

It is of course to be under
the conductor of each co
riage or train, shall pay regar
the signal-arms which point t
as is now the established and
practice. When the lever P
free, both arms and lamps retu
original positions.

Where a station happens to be
by a curve, or there is a bridg
object close at hand to obstruc
then, instead of employing one
for both lines of rail, it may be
employ two posts placed at a gre
distance apart, one for each li
that case they may be worked in t
before described, or in either of
next directed to be adopted when
are made use of.

Fig. 1.



An apparatus constructed on the same principle as the preceding, but adapted to the case of a junction, where one railway runs into another, each of two lines of rails, and adapted to the working also of the switches at the points of junction, is represented in figs. 2 and 3. In this case, the platform (A) is supported on standards sunk in the ground, but to such a depth only as to leave a hollow space below it to allow of room for certain parts of the machinery which are concealed from view. Two signal-posts, No. 1 and No. 2, are employed, one for each line, and each carrying on opposite faces two arms and lamps, one set for each line of rails. Each arm has, however, in this case, but two positions: one straight out, which is a signal "to stop;" and the other half down, which is a signal "to advance with caution;" and in like manner each lamp has two lights, a red and a green, (two of the faces of the lamp being left blank) the red corresponding with the "stop" position of the arm, and the green with the "advance-with-caution" position. The rods (H H), which work the four sets of arms and lamps, terminate each at bottom in a lever P, of two arms of unequal length, which is centred on a pin projecting from the post. From the end of the long arm, a chain Q^1 is carried down through the platform, then over a pulley R, and thence across to the opposite side of the hollow space beneath the platform, where it is passed up again through the platform, and carried over a pulley V, mounted in a rectangular iron frame X, screwed to the top of the platform, from which pulley it hangs suspended with a stirrup U, attached to the end of it. A front view of the frame X, is given separately in fig. 4. U U U U, are the four stirrups of the four chains Q^1, which command the signal-rods H H; they are all on a line, and within a easy reach of an attendant standing in front of them, who has but to press down with his foot the stirrup of the chain which he wishes to act upon. Immediately behind the frame X, and also within easy reach of the attendant, are two handles W^1, W^2, which command the switches at the junction-points of the two railways.

When the attendant signalises that the way is clear to a carriage or train to pass from one railway to another, which he does by pressing down the stirrup which commands the left arm and corresponding lamp, (that is to say, the left arm and lamp, as regards the driver,) and thereby at once lowering the arm halfway, and bringing the green face of the lamp in front of the coming carriage or train, he at the same time, or immediately before, or immediately after, stretches his arm over the fr and pulls towards him the handle commands the junction switches. moving his foot from the stirrup, free at the same time the switch-han signal-arm and lamp are immediat stored to their original positions by terpoise Y, which is suspended from Q^2, attached to the short arm of tl P, and passed down through the pl The arm remains always extended out, until it is lowered by the attend when in that position the red light i cessity invariably exhibited, so that t attendant has, by lowering the arm down and thereby bringing the gre in front, intimated that he has the switches, and that the way is c unmistakeable warning is given coming carriage or train that there i in advancing.

In situations where it may be d that the signal-arms and lamps sh acted upon from a greater distance t be conveniently reached by chains, tentee proposes to employ a metal a series of tubes, which shall comn at the end where the signal-man is s with a bag or case, made of vulcanize chouc, gutta percha, or some other and waterproof material, and at tl end, or that end adjoining the arm a levers H, with a like bag or case, each bag or case shall be enclosed i with a lid attached to the box all ro some air-tight elastic or flexible which will allow of its rising and f acted upon from beneath. These b intermediate tube or tubes are to with air in a state of considerable c sion. To the lid of the box at th post end, there is attached a jo which, on the rising of the lid, pul the arm and lamp-levers H. It that when the bag or case at the e the signal-man is stationed is co by means of a screw-plate, shifting or otherwise, a rising motion will stantly communicated to the lid of at the other end, which, through dium of the joint-rod, will impa scending motion to the signal-rods removing the pressure from the cases, the enclosed air will of cours mediately restored to a state of equ and the arms and lamps return original position.

The reflectors of the lamps are m parabolic section, and protected in the coloured glasses, which are m convex form, and fixed hermetically their places. With oil, the paten the ordinary Argand burner; but w

oyed, he uses, in preference to any rdinary gas-burners, one possessing owing peculiarities:—The nozzle is l by a cylindrical ring, and is made with a conical top, and the holes in erced obliquely, so as to cause the streams of gas to impinge against s of the cylindrical ring.—A rod, upwards from the throat of the ply-pipe through the nozzle and to erable height above it, where it ter-in a circular spreader. By thus the streams of gas to diverge at towards the sides of the cylindrical d carrying the spreader so much an usual above the nozzle, the pa-btains not only a much broader but longer flame than usual, and at the ne ensures a more perfect combus-he gas. The burner, whether of the form, or of the above improved form, made of brass, or iron, as usual; Stevens prefers making it in man-owing:—"I first cast a core or f the required form in some metal rial easily fused or melted, as zinc, or wax; I then, with the aid of an battery, deposit upon it a covering er (the mode of doing which is well or other hard metal; I afterwards melt core, which leaves the burner com-quiring only a little finishing to be r use; I thus obtain a burner, which, extreme thinness, offers much less ion to the currents of gas and air se made in the ordinary way, and lso, from the greater purity of the which it is composed, is less liable ion, and will last longer."

—◆—

WAY BUFFERS. BY SIR GEORGE EY, BART. (IN CONTINUATION FROM).

Your Birmingham correspondent, .," asks, very properly, "What e the effect upon the rods when 'er might be three or four inches or lower than the other, and con-y, *both* bearing within the cy-box? I presume this, with rs from the agitation, would soon the free working of the rods." ny communication was sent to n the subject of locked buffers, taken every opportunity in my f examining, on various lines, the accuracy with which the op-uffers of contiguous carriages, as de, would admit of the lock prin-ing applied to them; and I am find, that a large proportion of carriages have their buffers so unequally arranged as to elevation, frequently varying three to four inches from being central to each other, that if furnished with the cylindrical caps of the locked buffers, they would never have the opportunity of showing the evils "G. M." suggests; for they could never efficiently coincide, so that one could *grasp* the other—without which the proposed locked action is not effected. Whenever they are central enough to grasp each other, these evils would not occur. It is mainly in the elevation and depression, and not in the lateral position, that the present irregularities take place. Of course, they are *intended* to be central; but from the want of proper means of adjustment they fail in this respect; and when that failure approaches nearly to half the width of the buffers, they are then in a dangerous position, and ready to override each other.

If the locked buffer principle be capable of nearly extinguishing the risk arising from a great class of accidents—though it cannot, as I at first thought, be applied to most of the carriages in present use, without some adjustment in the beds to which the springs are attached, so as to regulate their height; yet, surely, if these carriages do admit of any such arrangement, the experiment ought to be tried on some of those that fit each other well, and then extended to others, as experience proves the advantage of the principle. In new carriages, the beds of the springs should be so made as to enable the buffers to be adjusted, by regulating screws, to one uniform elevation, when unloaded. There is no necessity to make the receiving-box of the buffer a tight fit to its opponent; an inch of play between the iron posts would be almost necessary; the soft stuffing alone ought to be a tight fit, and that only when fully up, the receiving-box being conical to admit of their meeting, although some irregularity of elevation may exist.

The question of central buffers, instead of side-buffers, is noticed also by your correspondent "G. M.," and it is a point that deserves much more consideration than it appears at a glance to demand. The violent lateral vibration of each carriage separately, is the great evil to be overcome; and, by some means or other, a train ought to be so firmly connected, that its action, as a whole, should more

resemble the steady gliding of the long body of a serpent, than the loose rattles at its tail. The tension by which each carriage is dragged forward, is, by the present screw-shackle, *central;* and no doubt it ought to be so, for this central tug, fore and aft, generally tends to draw each carriage from its lateral vibrations, which when in excess may carry it off the rail; yet a central tug, if unconnected with the broad lateral bearing of the present buffers, might, when the two contiguous carriages happened momentarily to coincide in lateral vibration, prove no check to each other. The buffers being tightly braced up, makes each carriage partake in some measure of the movements of the two others it is thus connected with; and the locked buffers will very greatly increase this beneficial action, as it does not permit of any *side* slipping, and compels each carriage to take a sort of average movement, which in a train, being the result of many incongruous impulses, will be nearly neutral.

The operation of buffers of any sort in their present position, when the train is passing a curve, requires ample consideration upon sound data as to the forces in action in any particular case. Take the following, as a rough approximate estimate of an average case:—Suppose a train to consist of twenty carriages, weighing four tons each; and that on an average of weather, dust, &c., the traction of the engine amounts to a hundredth part of the weight of the train; then the tension on the central screw-shackle between the tenth and eleventh carriage, is the hundredth part of forty tons, or about 900 lbs. Suppose the train to be passing on an abrupt curvature of fifty yards radius, and that the buffers had been drawn up to bear firmly against each other when on a straight rail, the force required to commence a movement in any of them is about 200lbs;* and at this curvature the inner buffers will be compressed about two inches and a half each, which will generate a force of about 550 lbs., or more than half that of the tension of the shackle. The shackle therefore becomes a fulcrum, around which each carriage endeavours, by the force of its compressed inside buffers, to restore itself to a direct line. The external rail receives this lateral pressure, about 16 feet from the fulcrum, by the flanches of the two furthest wheels of each contiguous carriage. The compressed buffers operate at a distance of about 2 feet 10 inches from the fulcrum; and hence the pressures, being inversely on their distances from their common fulcrums, the force of these wheels against the rail will be about 90 lbs., operating to shove the wheel over the rail, and taking advantage of any occasional jumps or lift that may occur to aid this force. If the buffers were *locked*, this side-pressure would be distributed along the line of carriages; and the *general* action of the train, as a whole, would be obtained; all the carriages partaking in part of any nascent irregularity of movement in any particular carriage, which would be thus prevented going beyond its due average of lateral action, and also of vertical jolting.

We are too far from a "perfect system," as one of your correspondents says, to go more accurately or minutely into this sort of reasoning, and this rough sketch may suffice for the present as to this part of the subject. When fearful destruction, on some sweeping scale, has taxed human invention to its utmost to make railway travelling as safe as the case admits of, other views will become open to us. I will venture one hasty glance at the shadow of the coming time.

In the first place, light-formed carriages, as now used, which have been rashly adopted from those in use on our common roads, have to be superseded by those more appropriate to the altered nature of the case. These carriages will probably consist of such strong diagonally-braced framework of wood and iron as will defy all "smashing." The interior may be as elegantly adorned, and as softly stuffed, as the most delicate lady may require; but the framework, however ingeniously it may be concealed, must be like the shell of the tortoise, strong enough to preserve the *living* principle within. These carriages will require to be firmly coupled to each other, fore and aft, by a strong vertical bolt, removable at pleasure, which may pass through an eye in two iron straps or connecting-rods, that form part of the

* I measured the power of the buffers manufactured by Messrs. Wright and Co., and it seems that the force required to commence any movement of an ordinary buffer is about 200 lbs., the spring being so adjusted. The range from this commencing point is 1 foot; and the ultimate force when pressed home is 1,960 lbs.

Fig. 2.

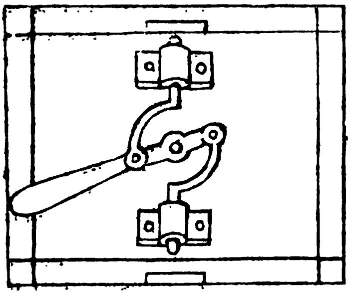
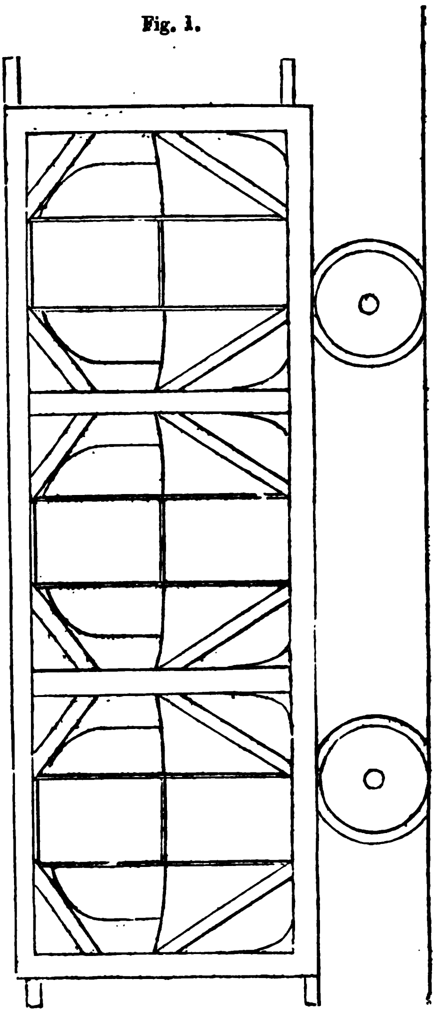


Fig. 1.



roof and floor of each carriage, and are central with the carriage lengthwise. These connecting-rods will exceed the length of the carriages sufficiently to admit of some sort of buffers on each side, so that the train may accommodate itself to curves. But as such buffers will have no effect in softening concussions, this construction implies the necessity of having a carriage entirely contrived for buffing, placed at each end of the train, as has frequently been urged as the best means of safety from collision; and in time i will probably be found necessary to do even more, and allow a buffing-carriage to intervene between some given number of carriages in every train. Figs. 1 and 2 will give a general idea of such carriages, and the means of bolting them together readily and firmly; fig. 2 being an end view of the body of the carriage and bolt only.

It is evident, that by this method of coupling carriages so strongly framed, a train might pass over 30 or 40 feet of broken bridge, or embankment, uninjured; all the carriages being suspended as on a firm beam or bridge of framework, more extended than the chasm—and even the engine and tender might be sustained, if so coupled, over many feet. If this be a dream of the shadow of the coming time, I admit it is a tolerably *substantial* one: but I affirm, that such results are positively within the range of mechanical invention; and the sooner they are worked out into a practical form the better.

I have now had an opportunity of reading Mr. Sutton's letter of June 20, 1845; and there can be no doubt that gentleman had an idea of *locked buffers* earlier than any one who has hitherto noticed them: his idea does not much interfere with my own views on this subject, as he confines them only to come into action at the time some strong shock is received by the train, by which it is stopped. I want them for constant service, and for several other purposes. Mr. Sutton says, "If these buffers are furnished with a plug and key-sort of adjustment, they may, when a severe shock takes place, become firmly keyed or locked into each other; and thus the whole line of carriages, at least those which are in the vicinity of the shock, will become as one body, immovable; no running over each other, or overturning,

as they are, as one carriage, firmly united with the buffers, but which may be instantly disconnected by suitable gear." Mr. Sutton's buffers, if well carried out, would probably have prevented the accident at Wolverton; and he has the credit of inventing them before that accident led others to think upon the subject.

I am, Sir, yours, &c.,
Geo. Cayley.

SAFETY TELEGRAPH FOR RAILWAY TRAINS.

Sir,—Frequent is the occurrence of accidents to passengers in railway trains, which might be mitigated or prevented were any means in use of warning the engine-driver of their danger.

Some suggestions for this purpose have been before the public, of the inefficiency of which their non-adoption is proof. The recent invention of a whistle, to be sounded by the guard of the train, is the best of these, and, within the limits of its applicability, very good; its protective agency is, however, but partial, since grievous casualties may occur beyond the cognizance of the guard; or a train may be severed by the fracture of the link between two carriages, and the guard, with his whistle, may be left in the lurch, out of hearing, before the signal could be uttered.

A suggestion is here offered, which occurred to the writer while reflecting on the inadequacy of this and similar contrivances to the purposes of safety.

Let the last carriage of every train contain a guard and a small voltaic battery; from this battery let one of the conducting-wires proceed directly to the axle of one or both of the pairs of wheels of this carriage, with which contact may be maintained by a spring. Let the other conducting-wire pass out at the fore-end of the carriage, just under the roof, and there terminate in a spiral link of wire of sufficient length to reach to the carriage next in front. Let the next, and each other carriage of the train, up to the tender, be furnished with a wire running under its roof, from end to end, not in contact with any metallic part of the carriage. Let each such wire be continued at one extremity by a spiral link, for attachment to the wire of the next carriage. Let each vehicle occupied by human beings be supplied with pairs of forceps, one at least for every c[illegible] ment; and let each of these [illegible] enclosed in a case, with a glas[illegible] sealed in, in some conspicuous a[illegible] venient position, so that, in case of the glass might be broken, and t[illegible] cut. Or, instead of these last, longitudinal wire be interrupted, compartment of the carriage, by contact breaker, in a glazed fr[illegible] which the guard should keep t[illegible] let this officer satisfy himself starting that all the contacts are [illegible] on;" then the "Danger-signal" made by a single movement indi[illegible] a plain direction lettered on each

This arrangement being rep[illegible] every carriage up to the tender, system be continued by an insula[illegible] running to the fore-part of the and here let it enter the alarm ap[illegible] which should be insulated, and [illegible] but out of reach of, the engin[illegible] stoker; the guard having the key

Let this alarm consist of a sm[illegible] tro-magnetic core and coil; the a[illegible] of the magnet being adjusted as th[illegible] of a clock movement. Let the cl[illegible] be connected with a bell, so that, release of the detent, the spring [illegible] free to act, and the bell shall co[illegible] to ring violently, and continue t[illegible] till the detent be recalled by the [illegible]

Let then the series of condu[illegible] continued to the electro-magne[illegible] having formed its helix, let the w[illegible] on to the wheel-axles of the te[illegible] extremity being kept in contact th[illegible] by a spring.

The expense of this adjustmen[illegible] be trifling. The trouble it woul[illegible] would only be that of occasionall[illegible] ing up the alarm-spring, of tigh[illegible] little binding screw between e[illegible] carriages on making up the train keeping the battery charged; a last item might be eliminated by tuting for the battery a magneto-apparatus, the revolution of whos[illegible] ture might be made to depend on the wheel of the carriage.

It is clear, that, so long as co[illegible] maintained, the "current" w[illegible] through the series of carriag[illegible] through the alarm, and back thro[illegible] rail to the battery; and that wh[illegible] either the guard suspends contac[illegible] battery, or a passenger cuts th[illegible] ductor, or the train breaks, or

(the most liable to do so) gets
ail, the "current" will instantly
e clockwork will be freed from
net, the bell will ring, and the
l soon be stopped.

only errors to which the system
e liable, are false alarms on the
. These might occur by a pas-
wantonness,—not likely to be
; or by momentary non-conduc-
ween the rails and wheels; and,
ase, conduction would probably
ned, and the bell would cease to
ore the engineer could have done
an shut off the steam.

d the last error be found to occur
ently as to be inconvenient, the
night be maintained by a second
ires similar to the first, instead of
to the rail: this would add but
mplication to the scheme, and
nly sacrifice the additional safety
hance of the last carriage quitting
without the instant knowledge of
pant.

ng, that, if this sketch should be
worthy of a place in your pages,
e intelligible to your readers,

I am, Sir, yours, &c.,

C. B. M.

, 1847.

LGEBRAICÆ. BY JAMES COCKLE,
., M.A., BARRISTER-AT-LAW.*

(Continued from page 308.)

V. SURD EQUATIONS.

e equation

$\sqrt{1+x}=0 \ldots\ldots\ldots\ldots\ldots (1)$

the positive value of the radical
e taken) for x substitute $a+$
, a and β being any real quanti-
Then (1) becomes

$$1+\sqrt{1+a+\beta\sqrt{-1}}=0$$

s equivalent to

$$1+a'+\beta'\sqrt{-1}=0$$

β' being real (*a*). Hence

$$\beta'=0, \text{ and also } \beta=0;$$

ently x is real. But no real value of x can satisfy (1), for, if so, we should have the sum of two positive numbers equal to zero, which is absurd. The equation (1) has, then, no root real or unreal—a result "very startling to all our preconceived notions of the constitution of an equation" (*b*).

In a valuable "NOTE," at pages 130—133 of the fourth edition of his *Algebra* (*c*) Professor Young treats the equation

$$(2x-5)+\sqrt{x^2-7}=0,\ldots [A]$$

in a manner the same in principle with that just employed in the discussion of (1). He there shows that no real and no unreal value of x [that is to say, no unreal value of the form $\beta\sqrt{-1}$] can satisfy it (*d*). But when x is assumed to be of the form

$$a+\beta\sqrt{-1}.$$

is the argument of my distinguished friend still applicable? It appears to me (although I say it after considerable hesitation, and with great diffidence), that in this latter case, owing to the obliteration of the original conditions by involution (*e*), combined with the uncertainty and difficulty that attend all attempts at the solution of surd equations (*f*), we shall not easily arrive at a positive conclusion as to the non-existence of roots of [A]. Such a conclusion would follow at once from a consideration of the effect which the existence of a root of [A] would have on its congeneric equation (*g*); but I do not at present see anything on the face of the given equation to indicate that its solution is impossible (*gg*).

Let it next be required to solve the equation

$$10-2x-\sqrt{(4+x)(5-x)} = 0 \ldots (2).$$

Transposing the radical, squaring, reducing, &c., we have at length

$$(-x)^2+\frac{41}{5}(-\ )=-16$$

or, solving this last equation as we have already done a previous one (*h*),

$$-x+\frac{41}{10}=\frac{9}{10},$$

* *oræ* were interrupted during part of August
resent month by Mr. Cockle's absence in
and Belgium. Mr. Cockle hopes now to
them alternately with the remainder of
ters on Analytical Geometry, commenced
ork. *Coston*, near *Waltham*, *Melton Mow-*
ptember 25, 1847.

(*a*) Professor Young's *Algebra* (4th ed.) p. 115,

(*b*) *Gentleman's Diary* for 1837, p. 34.

(*c*) London, Souter and Law, 1844.

(*d*) Page 132, lines 3 to 10.

(*e*) Young's *Algebra* page 131 (4th ed.).

(*f*) *Supra*, pages 135, 136.

(*g*) *Vide supra*, page 151.

(*gg*) And see a doubt expressed at page 128 of WOOD'S *Algebra*, (Mr. Lund's edition).

(*h*) *Supra*, page 135, equation (5).

whence $x=\frac{32}{10}=3\frac{1}{5}$.

The above equation (2) is congeneric with that proposed as the Example 8 at page 130 of Young's Algebra (4th ed.). I hope on a future occasion to give a set of Rules respecting surd equations. Suffice it to remark here, that it is not a matter of indifference to which of a number of congeneric equations we apply the symbolic test. The last equation (2) is of nearly the same form in every respect as those marked (5) and (6) *supra* page 135. In all three cases the available root is the *least* root, and one root of the final quadratic belongs to each of the congeneric equations.

(*To be continued.*)

CAST IRON GIRDER BRIDGES.

Fig. 1.

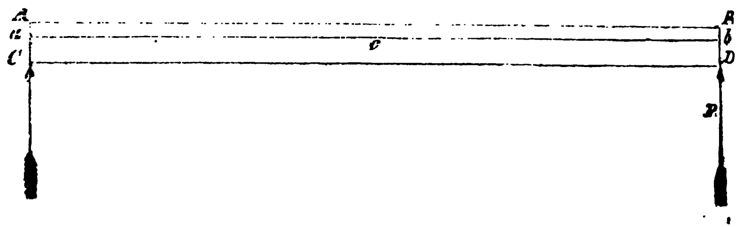
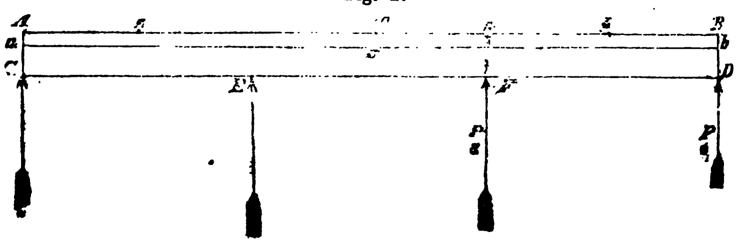


Fig. 2.



Sir,—Without, for the present, recurring to my original paper: Let ABCD, fig. 1, be a girder resting horizontally on the abutments CD. Put $2L=AB$, μ=the weight of each unit of the beam, and load, P_1 = the upward pressure of the abutment D, and let M = the sum of the moments of elasticity round any point c in the neutral line, when

$$M=P_1\overline{cb}-\frac{\mu}{2}\overline{cb}^2=\overline{cb}^2(P_1-\frac{\mu}{2}\overline{cb}.)$$

Which when c coincides with the centre of the beam $\overline{cb}=L$, and $P_1=\mu L$, or

$$M=L\,(\mu L-\frac{\mu L}{2})=\frac{\mu L^2}{2}\ldots\ldots\ldots\ldots\ldots\ldots(1).$$

Let us now suppose the girder be proped, as in fig. 2, by the props E and F, and suppose these props to divide it into three equal parts, then $CE=EF=FD=\frac{2}{3}L$. Put P_2 = the upward pressure at D, and P_3 = the pressure F, then if M = the moments of elasticity round any point c, in the neutral line between the props E, and F, and μ_1 = the weight of each unit of the beam and load,

$$M=P_2\overline{cb}+P_3(\overline{cb}-\overline{FD})-\frac{\mu_1\overline{cb}^2}{2}.$$

Or if c be the centre of the girder, then

$$M = P_2L + P_3(L - \frac{2}{3}L) - \frac{\mu_1 L^2}{2}$$

$$= L\left(P_2 + \frac{P_3}{3} - \frac{\mu_1 L}{2}\right) \ldots\ldots\ldots\ldots\ldots (2).$$

is the same as the equation in I.'s" communication. Now, *on position* that the abutments and ach support symetrical portions beam, the abutment D would have on it half the weight of the ınd load between D, and F, or the

pressure at $D = \mu_1 \overline{zB} = \frac{\mu_1 L}{3} Bz$

being $= \frac{1}{2}$ of $ED = \frac{1}{2}$ of $\frac{2}{3}L = \frac{1}{3}L$. Similarly the prop F would support the beam and load contained between the points y and z, or the upward pressure at $F = \frac{2\mu_1 L}{3}$ because $yz = \frac{2}{3}L$: and so on for the other prop and abutments. Substituting these values for P_2 and P_3, equation (2),

$$M = L\left(\frac{\mu_1 L}{3} + \frac{2\mu_1 L}{9} - \frac{\mu_1 L}{2}\right) = \frac{\mu_1 L^2}{18} \ldots\ldots (3).$$

ɔaring equations 1 and 3,

$$\frac{\mu_1 L^2}{18} = \frac{\mu L^2}{2} \therefore \mu_1 = 9\mu \ldots\ldots\ldots\ldots\ldots (4).$$

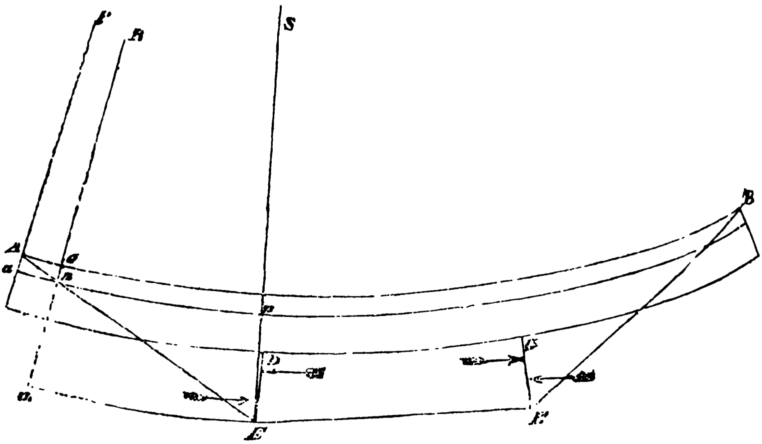
:h is the same result as I arrived my first paper, and must be if we *allow* the *assumption* as the upward pressure on the I have given my reason for as- these relative values of P_2 and can say no more on this point, than that I think I am borne out rinciple by writers assuming that the *vertical* rods of a suspension- re strained *in proportion* to the *they are apart.*

ɔregoing equations are not brought :tly on the principle I originally ɜd: for I then intended your to imagine the girder separated ɛe distinct parts or segments, by ıt through, over the props E and F; the sake of easy comparison with going equations in my first letter, ıted it as though the whole load segment of the beam was collected respective centre. "A. H." will e see, that, with this view, there ı more forces to be taken into ation than was at first computed, the re-action of the abutment, h as it acted on a distinct and d portion of the beam, would not ect the condition of equilibrium parts of the beam. I might not, ɔriginal paper, have expressed so clearly on these points; yet, ey are taken into consideration, ɔning will not appear so absurd as "A. H." would lead us to suppose. Neither did I contradict myself when I said, "the reason I assume $\frac{2}{3}L\mu$ to be the weight on each prop," &c.; for "A. H." will see, that, if $\frac{2}{3}L\mu$ be the *weight* supported by F, μ, $\frac{1}{3}L\mu$ will be the *upward pressure round the centre c*, if the girder is divided in the line n F, the remaining $\frac{1}{3}L\mu$ being an upward pressure acting on the segment FB.

With regard to the next question, "A. H." and myself seem scarcely to understand each other. In his first letter, his observations seem to imply, that the inclined bars AF would give way before the bars EF. Diagram, fig. 2, in his last letter, appears to refer to the props ED, GF, which he apprehends would be broken by the cross strain, as represented by the arrows.

With regard to the bars AE and BF, I have in a previous letter shown that they are not as much strained if fixed to the beam at A and B, as the horizontal truss-bars EF; but, lest there should be any doubt on this point, draw a AP, (fig. 3) mno R, E ps normals to the neutral line

Fig. 3.



at the points a, n, and p, and from E draw Em parallel to np. Now, for a moment, let us suppose n to be a solid abutment in the neutral axis, and the bar AF to be divided at the point which coincides with it; and let the upper segment An be fixed at A and n, and the beam deflected by extraneous pressure till it assumes the curve above represented: then, because a n is the natural length of fibre, and Ao is a parallel fibre, but by reason of the pressure reduced in length, it follows that any line joining the points An will be proportionably reduced, and therefore proportionably compressed; and because the line Em is longer than the line np, measured on the neutral axis, any line joining the fixed points n and E will be extended.

Hence, taking the whole bar AE, the total extension will be equal to the difference between the extension and compression of the segments considered separately.

I would have replied to "A. H." earlier, but preferred letting the subject stand over until after my return to London.

I am, Sir, yours, &c.,

WILLIAM DREDGE.

P.S. In my last letter, p. 206, col. 1, line 46, read *cosec* for *cos*.

10, Norfolk-street, Strand,
Sept. 23, 1847.

AYCKBOURN'S FLOAT, LIFE-PRESERVER, AND SWIMMING-BELT.

[Registered under the Act for the Protection of Articles of Utility. Mr. F. Ayckbourn, 30, Palace New Road, Lambeth, proprietor.]

The present Life-preserver is distinguished from other inventions of its class in being constructed so as to be worn under any article of clothing, either by male or female, and in requiring to be but partially inflated, so that it can never burst. Unlike other belts, too, its supporting medium is applied to the chest, which is the part of the body obviously most in want of its aid, owing to the superincumbent weight of the head and shoulders. When used simply as a life-buoy, it is stated to be capable of supporting three or four people.

To construct this life-preserver, two pieces of cloth, which have been previously coated on one side with dissolved India-rubber, are cut into the shape represented in fig. 1, and passed between rollers, to make their coated surfaces adhere together, after which the compound piece of cloth is doubled or folded over into the form shown in fig. 2. The two outer edges of the cloth, as far as the dotted lines, are then coated internally with liquid India-rubber, and a strip of the waterproof material, before mentioned, coated with India-rubber, laid between the edges of the cloth, so that the centre of it comes where the open

Fig. 1.

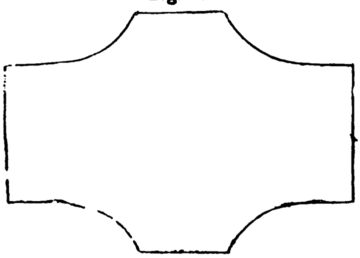


Fig. 2.

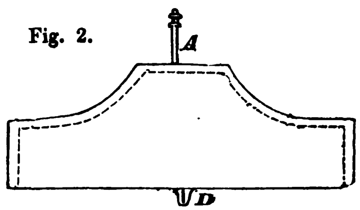
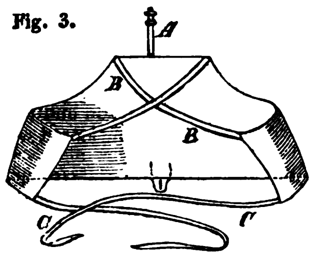


Fig. 3.



sides of the preserver are united. When the edges are thus firmly cemented together, the article forms an elongated bag, both air and water-tight. A is a short piece of vulcanized India-rubber tubing, by which the bag may be inflated with air at pleasure; B B are two straps, for passing under the arms and over the neck of the wearer; C C are other straps which tie in front, after passing through the loop D. Fig. 3 shows the article in its complete state.

CURR'S "RAILWAY LOCOMOTION AND STEAM NAVIGATION: THEIR PRINCIPLES AND PRACTICE."*

The circumstances under which this book has been written, the evident wish of the author to be useful, and, we may add, the amusement some of his declamations have afforded us, induce us to give to it a more extended notice than it would otherwise have any claim to. It appears that Mr. Curr, whilst an engineer in England, some thirty or forty years ago, had a dispute with several of his professional brethren (Mr. Maudslay amongst others), and was so disgusted at "finding ignorance silvered over with plausible appearances," that he quitted the profession, and transferred himself and his acquirements to New South Wales; where, however, it does not appear that they were any better appreciated. A railway being proposed from Sydney to Goulburne, Mr. Curr sent in to the Committee his plans:

"Although thirty-two years had passed since I relinquished that profession, I was induced to commence an examination of the principles of steam conveyance on railways; the result of which was laid before the Committee in different papers, and forms the matter of the following pages, in so far as they relate to that subject. That those papers were considered valueless, and consigned to the shelf of oblivion, was evident from their subsequent report; but, knowing them entitled to consideration, they were put in the form in which they now appear, with the intention of being made an eleemosynary tribute to the British Government, for the benefit of the British nation, if, by chance, their usefulness or value should be detected."

The *Inflexible*, sloop of war, Commander Hoseason, arriving in the harbour of Port Jackson, induced Mr. Curr to inspect her:

"The result of that inspection was a suspicion that steam navigation, notwithstanding the thirty-five years which have expired since its importation across the Atlantic, is no better understood than on the day of its being landed; and which, by a careful examination of two volumes and two odd numbers of the *Mechanics' Magazine*, made in order to ascertain the present actual and scientific knowledge of English engineers on the subject, was fully confirmed. In consequence, the above-named charitable intention has been abandoned. * * * The result of such change of purpose is, that of having quitted a peaceful homestead in the fair clime of Australia, and these lines are being penned on board the ship *St. George*, bound from Sydney to London; so, that, in the monotony of passing over 16,000 miles of the hungry ocean, where all above the horizon is interminable blue, and all below differing only in shade and extent, an occasional excursion from the straightforward path becoming an essay on mechanical subjects, may in this address find pardon from the reader."

* 181 pp., 8vo., Williams and Co., 1847.

It is not often that authors can plead such an excuse for their rambling. To confine the body in a ship's cabin, and the mind to a straightforward argument at the same time, is certainly rather more than can be reasonably expected, and we are thereby enabled to attribute the want of connection in the writer's reasoning to the lurching of the ship, and the obscurity of his notions to a passing fog.

One of the chief objects of the book is, to arouse the nation to a sense of the awful peril they incur in trusting to "Hutton's Mathematics." Our readers have been accustomed to look upon their copies of this work as, at the worst, a very harmless mass of paper and ink, little dreaming of the fearful destruction with which it is fraught. "To his (Hutton's) doctrine of hydrostatics might fairly be attributed the bursting of steam-engine boilers, the blowing up of public sewers, and the breaking down of brewers' vats; so that his course of mathematics is equally a national misfortune and disgrace," (page 49). Against poor Hutton, and "all his followers," Mr. Curr is determined to wage war—"war even to the knife." To assuage in some degree the mortal antipathy which Mr. Curr feels towards all critics, as set forth in the concluding paragraph of his book, (and which we shall treat our readers to presently,) we beg most solemnly to assure him that we are quite innocent of ever having read one line of Hutton's Mathematics, and know nothing whatever about it; excepting the last edition, edited by Professor Davies, in which all the parts relating to mechanics and hydrostatics have been removed, to make way for more extended treatises on geometry, &c. Consequently, we are really quite horrified at the account which Mr. Curr gives of the work, which horror, however, is somewhat alleviated by the ludicrous:

"We will, however, follow the doctor to a practical case, when we shall see the capers he cuts, and the agility he displays in endeavouring to extricate himself from the shaking quagmire on which he finds himself: viz., to shift the momentum from v, as given in his original theory, to v^2 in a practical case."

The idea of old Hutton cutting
a shaking quagmire, is one of
pleasing and refreshing images
been presented to our imagination
time, the scene being enhanced, if
by the introduction on the stage
Tredgold, whom he (Hutton) le
own quagmire"—the two philosoph
ing a jig on the said quagmire to
of v^2!

As a specimen of Mr. Curr's
mechanics, we extract the followi
we have no doubt will be abunda
cient:

"W. Emerson, the translator of
Newton's Principia, and the only
of the past century" (the mono
have been a valuable one,) "has
relative momentum of a falling
compared with the same at rest, an
Let b=body or quantity of mat
accelerated force acting uniformly an
on the body b; v=velocity gener
by the force F; m=the motion gen
b (by some writers, as he says in h
tions, called the momentum); s=
scribed by body b; t=time of d
space s. Amongst other rules o
tion, he makes m proportional to b
to the product of the quantity of m
velocity. Before proceeding in th
nation, it will be proper to have
perception of the term velocity,
the case before us, may be disting
absolute velocity and acquired veloc
solute velocity, according to the d
of both Hutton and Emerson, is t
passed over by a falling body in res
body at rest, and, consequently, is
the space or distance the body has f
that absolute velocity is taken or m
irrespective of the time of falling.
velocity has not been especially de
either writer, and therefore will be
the sense in which the term is un
used, viz., the velocity in respect
particular time, usually in feet in the
one second; or as the space in f
would be passed by the body in one
in case its velocity were to be conti
formly after having assumed that vel
second. I now say the obvious plain
of Emerson is, that m, the momentu
rated in the body b when it has be
on by the force F, and has descri
space s, whatever be the time in
has described that space, is proport
bv, or to the product of the body
absolute velocity; being equivalent

of the body and the space it has and which is consequently the weight ody multiplied by the space it has Dr. Hutton, treating on the same says,—Put b=any body or quanmatter, f=force constantly acting t=time of its acting, v=velocity d in time t, s=space described in ie, m=momentum at end of that The plain reading of Hutton then is; omentum at the end of the time t, e body b has been acted on by the and acquired a velocity v in that l whatever space it may have described ime, is proportional to bv, or to the f the body multiplied by the *acquired* The acquired velocity being as , or as the square root of the absoocity, Hutton and Emerson consediffer as bv to bv^2, although each rehe momentum in the same symbols, portional to bv."—(Pages 37—39.)

ıld be difficult for any man to give nvincing proofs of his utter and ignorance of the very first elef dynamics, than are contained in act. The confusion and complete of anything like one distinct idea of meaning of the terms used in mecould not be more thoroughly ed. Without ever having read Emerson's Mechanics," or Hute venture to assert, that no such as that "of absolute velocity" d by Mr. Curr is to be found in ks The distinction between *absoacquired* velocity exists nowhere the author's own confused notions. queerly worded, he does seem to thing like a correct notion of that terms "acquired velocity," and only velocity ever thought of, or or written of, by any author on t. It is not a gracious office to tell a man for whom, both on achis age and the labour with which ideavoured to acquire knowledge, ain a sincere respect, that he has m the very alphabet of the science professing to teach. The subject, ll aware, is one of extreme diffievery beginner; and when, as in 's case, he is deprived of all assistresidence in such a place as Australia—and at an advanced age has to grapple with what we have no hesitation in saying are very formidable obstacles to every one—it is no disgrace to fail. One-tenth part of the labour which Mr. Curr has evidently bestowed on the matter, *if it had been under proper guidance*, would have not only prevented his committing himself by writing such a book, but have probably enabled him to do good service to others from having acquired distinct knowledge himself. These remarks apply to the whole contents of the book. Facts and laws "as old as Adam" are to the author as utterly unknown and new as to any inhabitant of the Australian bush: of this we shall see presently a very striking example in his observations on the expansion of steam. To return, however, to the "velocity" question: —When Galileo first began to lay the foundations of dynamics, two centuries and a half ago, he imagined that the velocity of a falling body increased in proportion to the distance over which it had passed—but he very soon found out his mistake; and no one has ever since dreamt of such a thing that we know of, except Mr. Curr, whose notions look very much like it. We cannot convert this notice into an elementary treatise for Mr. Curr's benefit; but as he has done this Magazine the honour of considering it as the exponent of the "present actual and scientific knowledge of English engineers," we take the liberty of suggesting, that he may find something to assist in enlightening and clearing up his conceptions in some of the recent numbers of this Journal.

With regard to the author's observations on railways, the reader will be able to judge of their value, by the simple fact that Mr. Curr takes for granted, almost as an axiom, that "when the velocity of an engine is doubled the friction is doubled," and so on! We again take the liberty of informing Mr. Curr, that really other people besides himself *have* inquired into these matters, and that thousands of experiments have been made by some of the most careful and skilful men, the results of which he may

find in almost any modern work on the subject; (as, for instance, "Moseley's Illustrations of Mechanics; or, Treatise on Engineering and Architecture,") and the results are, amongst other laws, that the friction "is wholly independent of the velocity of the motion."

Some remarks are made about the economy of high speeds, as compared with low ones, which are in some respects true enough, and also stale enough—the amount being pretty nearly to the effect, that if an engine go at twice the speed, and therefore in half the time, the wages of the engineer and other servants will be also halved. Q. E. D.

Some of the remarks on the precautions against accidents are sensible enough, but if they have not already occurred to 99 out of 100 engineers, it would be rather wonderful.

One sentence, however, is *really* worth quoting—something positively new:

"Actual collision of trains, moving in opposite directions, is a subject scarcely deserving attention; but as there appears a vulgar notion amongst persons who ought to know better, that if two trains meet the shock is proportional to their joint velocity, or to twice the velocity of each train, it may be said the shock sustained by each train is proportional to its velocity; and the same is true as respects each person conveyed by it." !!!

Now, is not this *rich?* Behold some of the fruits of Mr. Curr's notions about "absolute velocity!" Verily and in good sooth he need be such as he describes himself and "his master, Emerson," to be, if they are to undergo personally and practically such collisions on the faith of their theoretical notions about velocity:

"My old master, Emerson, had a clear head—so have I; but he has been laid on the shelf many years—so may I; he loved the truth—so do I; spoke it to his critics—so will I (?); *bowels of gutta percha, heart of leather, brains of fire*—so likewise have I; but this is muttered for their private ear; he hated critics—so do I."

Hear! hear! hear! In no conceivable case, we imagine, could "gutta percha" bowels be so desirable as in so perilous a case. We advise the Gutta Percha Company in their next advertisement to [...] by the suggestion, and insert amon[g] other thousand-and-one purposes t[...] this twistable commodity is app[...] "Very desirable to all those who [...] periment on Mr. Curr's notions o[...] city, and are disposed to try by a[...] smash the correctness of his theory [...] lision." The "heart of leather," o[f] [...] must not be forgotten.

Mr. Curr's notions about the ex[...] of steam are pretty nearly as origin[al] [...] the law of Boyle and Marriotte, est[...] centuries ago, and recently verified [...] haps the most careful series of exp[...] ever undertaken—viz., by Arago a[...] long, at the request of the French [...] ment—he seems entirely ignorant [...] law is, that the pressure of steam [...] other gas, is proportional to its de[...] inversely proportional to the space [...] pies—provided only the temperatur[e] [...] the same. Being in utter ignorance [...] our author once actually fancied th[...] promulgated for the first time in [...] vol. xlvii., *of this Magazine!!!!* [...] happy indeed would the writer of th[...] alluded to (who was not Professor D[...] Mr. Curr imagines, but another corr[...] ent of the Magazine) no doubt be, [...] had the honour of such a discover[y] [...] the law is made use of in the cours[e] [...] article, as one so well known to ev[...] that it would have been impertinent [...] any formal allusion to it. Mr. Cu[rr] [...] ever, did arrive at the wonderful di[...] that this law (of the proportionalit[y] [...] pressure to the density) was *not* brou[ght] [...] ward a few months since in this Mag[azine] [...] the first time—and in great glee h[e] [...] note to his book, to proclaim this re[...] antiquarian researches. He has [...] traced it back to the era 1833, and [...] in "The Millwrights' and E[...] Pocket Companion"—whence M[...] very logically concludes, that "thi[...] may be taken as a new edition of [...] which has been in print for fourteen [...] There's a discovery for you! In [...] for this unprecedented investigati[...]

y, we will take him back to the year ed, in an old musty book of Robert shew to his astonished optics the ement of the law in question as air; and then, in every elementary k physics that has been published at day to this, point out where he d the said law explained or referred to ded to steam and a variety of chemical together with a number of other useful rtaining facts; at which he will be lighted, and to all of which he is y as new as the bear was to the ple. We have great fears, however, this will be as much thrown away n as the fruit was to the quadruped; he not proved, "since the particles are of a shape intermediate to the l the sphere"—that therefore "the re force of steam is as the square its expansion"—whatever that may With these very striking and self-ted notions, it is no wonder that gh," as he confesses, "with little owledge of the science than a dray-he sets to work to promulgate his as as to the thermometer.

what has preceded, the reader will at all surprised to hear that Mr. ing quite innocent of knowing that nt corresponding to Zero on the de scale is marked 32° on Fahren-acies he is drawing all sorts of ab-r out of the usual books on the of heat; whereas it is from his own d resources in that way that they One sentence will be quite sufficient the state of Mr. Curr's acquirements matter, and to justify his own as-that "he knows no more about it ray-horse." "Blood heat by Fah-s 98°, and Boiling water 212°, or as 1 Blood heat by Celsius 36.6°, and vater 100°, or as 1 to 2.73. There-s evident both scales cannot be cor-

ink we can convince even Mr. Curr ate *as* the task may seem—that he *ettle*" obfuscated here. Can he see comparison cannot be made, unless from a common starting point? The starting point, viz., the point at which the mercury stands when placed in melting snow, is marked 0 in Celsius, and 32° in Fahrenheit: so that 98° in Fahrenheit is 98°—32°, or 66° above the natural Zero: and therefore Mr. Curr should take the ratio of 66 to 212—32, or 66 to 180, instead of 98 to 212; and he will find, that $\frac{66}{180} = \frac{1}{2.73}$ the same as $\frac{36.6}{100}$ for the thermometer of Celsius, with a slight difference in the last decimal, owing to the actual point of blood heat not being quite accurately marked but only to degrees on the scale. From one thus absolutely unacquainted with the very rudiments of the subject, the reader will easily anticipate what may be expected in the parts where the application of the author's notions is made to steam navigation, &c.

For all the observations we have been making, however, the author seems to be well prepared. With a magnanimous defiance of criticism, he thus eloquently apostrophises all those who may dare to express their opinion of his book:

"But who proclaims himself my critic?—the shadow of a nonentity, whose only knowledge of the subject is derived from the book which he undertakes to criticise: no—it will be left to future ages to find the truth. Man is not to be convinced when truth is in opposition to his interest. Then you will make allowance for the opposition of a host of engineers and iron-masters, who may rise in arms to cry down this book. But the principles are ONE—so break one link of the vinculum, *and down goes my book to the shades below.*"

And there we leave it, as the bishop did Lord Rochester. We cannot conclude this notice, however, without expressing a sincere regret that so much labour and earnest endeavour to obtain knowledge and arrive at the truth, as we believe the author of this work has expended, should have no better result. "The little I have acquired" (and this, we fear, is a *minimum minimorum*,) "has been by unwearied study, often continued without intermission through days and nights; for by such exertion only are

Nature's laws to be unveiled." For such a man no generous mind can help feeling the deepest respect, however unsuccessful the effort. The author's case is by no means a solitary one. We have reason to know that there are hundreds of men at this moment—not exiled like Mr. Curr in such distant lands as Australia, but here in England, and in London,—who have wearied themselves for years in labours that *must* end in disappointment; because without any sound and rational foundation.

It is not long since we were favoured with a visit by a person who firmly believed he had solved the problem of squaring the circle, and had come to London to make it known. Without any knowledge of even the elements of Euclid, he had somehow or other arrived, by his own unaided reasoning, at several geometrical theorems, some of which are contained in Euclid, and others not—but which were, in fact, very legitimate deductions. We feel it beyond *our* power to convince such a man of his error, and of the impossibility of the problem he was attempting, by any appeal to principles and processes of which he was quite ignorant; but we have been since agreeably surprised to learn that a mathematician, whose name is well known to our readers, had been able, by reasoning with him in his own way, and on his own grounds, to convince him that he had made a mistake. Now here was time spent and labour thrown away which would have been abundantly sufficient, if properly guided, to have made the man a very decent mathematician. Such cases are far more numerous than would be imagined,—though perhaps not so much in mathematics as in the physical sciences. There is an immense mass of mental power completely thrown away and wasted every year. And such will continue to be the case so long as the present isolation of individual minds amongst the less educated classes exists. It is true that sometimes an original idea is in this way struck out which might never have occurred to one more influenced by the usual routine of study; but even such things never occur in the mathematical sciences, in which every one *must* ascend the steps of the same ladder as his pred to a considerable extent, before he competent to make any excursions own account in fresh directions. attempt to cut any such caper reaching a proper elevation, he is tumble down and break his neck. ardently to be hoped, therefore, th plan may be devised for securing possible, that mental as well as physi gy shall be exerted in a *useful* dir not meaning by that term to includ what canting classical sciolists and rary" gentlemen affect to despise, advancement of our *material* and interests—but using the word in general sense.

RETROSPECT.—ERRATA ET CORR —BY A. H.

Sir,—My attention has been cal frend to an oversight in an article page 107, vol. xlvi., of this Maga which, by a slip, I have written the for determining the motion

$$\frac{d^2\theta}{dt^2} - 2\,m.\frac{d\theta}{dt} + n^2\theta = 0$$

whereas the second term ought $+2\,m\frac{d\theta}{dt}$, instead of with the negat This will give the solution in a form. I did not consider it nece the time to say, that, of course, I believe in the possibility of a p motion; but it would have been a have mentioned—(as "Pen and Ink properly pointed out in the next n that if the friction exceeded a certai tity—the result would be *not* a p motion, but *no* motion at all. As t tion is a merely mathematical I should not have troubled you w note, were it not that I consider such errors should be acknowled corrected. The error in the presen moreover, one to which the mathe is very liable to fall, if he be at all and for which he may probably hav rather dearly—namely, the getting th sign for a velocity. The angle reckoned from the position of re disc, the linear velocity of any point be proportional to $-\frac{d\theta}{dt}$ and not during the time of its moving tow natural position. Such slips as t

eived in time, may give rise to nstead of sines in integration, velo- stroying each other's effect instead added, and, in short, to all sort of

take this opportunity of stating, rd to the series, entitled, "Use of atics," &c., that they were ex- ntended to be merely of the nature , and not as full and copious ex- s of the different points alluded to would require almost a treatise of There is abundance of room for xplanation and simplification, and onsider the utility of what has been considerably increased if it induces your correspondents as Mr. Wil- nd Mr. Oxley to go still further into er.

mon with many other of your readers, e glad to see the commencement of iscellanea Mechanica." Although novelty can be expected in such —the ground having been trodden ries by some of the greatest men ever lived—there is yet room for nking reader to contribute in some the progress of the learner: and those who are already acquainted subject, it is not without interest to node in which others view it. In ere is a need of something like a ' mathematical journal; for it is ary to say, that such ones as the idge Mathematical Journal," &c., ly useless to him. The Diary, too, ed to problems, and appears but ear. There is, therefore, actually newspapers call a "desideratum." erably certain, that a great number d and unassisted students would feel y thankful for such aid, and, on the nd, I do not think there would be those willing to lend them a hand.

mathematician *who deserves* the d who cultivates it, not for the sake f making books or getting money— *the love of the thing itself*—every ne must wish for the progress of nce, and be anxious to enlist into its ll who are able and willing to enter. o hesitation in saying, that I believe far more such men *out* of the uni- than in them—men scattered up n—who labour, and think for the thinking. I say this, from some knowledge of the fact; and I may s authority of Professor De Morgan, onal evidence. "As it is, however, n this country who pay attention to culty of mathematics for its own me to their pursuit through the s of taste or circumstances," &c.—(Preface to Differential and Integral Calculus.)

I am, Sir, yours, &c.,

A. H.

P.S. The following errata in the series on "The use of Mathematics, &c.," require to be corrected, as in some cases altering the sense, or making nonsense. Page 372, vol. 46, col. 1, line 12, for "$k=o$," read "$x=o$," and next line read—"and then comes down upon you with the Q. E. D.;" line 34, for "naturally," read "rationally;" and line 43, read—"to be had in part;" page 396, col. 1, for "Rise and abuse," read "Use and abuse;" page 425, col. 1, for "practical," read "practised." The accidental transposition of a paragraph from one column to another, in page 32 of the present volume, must also be rectified before any sense can be made of that article.

DETERMINATION OF THE LONGITUDE BY THE MAGNETIC TELEGRAPH.

[From a New York paper, as quoted in the *Athenæum*.]

The observations at the Washington Observatory were made by Professor Keith; those at Philadelphia by Mr. S. C. Walker; and those at Jersey City by Professor Loomis. These three observatories were connected by a continuous wire; so that telegraphic signals might be exchanged between any two of them at pleasure. In some of the first experiments, signals were exchanged between Jersey City and Philadelphia, and also between Philadelphia and Washington; but it was found impossible to transmit signals directly from Jersey City to Washington. The power of the battery appeared inadequate to that distance. But on the 29th of July this difficulty was overcome. Twenty clock signals were given at Jersey City, and recorded both at Philadelphia and Washington; twenty signals were given at Philadelphia which were received at Jersey City and Washington; and twenty signals given at Washington were received at Jersey City and Philadelphia. Thus the comparison of the three clocks was perfect; and thus the original plan of observation was fully carried out. This was glorious success, and enough to repay the observers for all their past disappointments. The same complete set of signals has since been again exchanged between the three observatories. The object of the observations has thus been completely attained.

The difference of longitude between Jersey City and Philadelphia, is *four minutes and thirty seconds;* and between Jersey City and Washington, *twelve minutes and three seconds;* omitting in each case a fraction of

a second which can only be fully determined when all the observations have been completely reduced.

It is not uncommon to hear doubts expressed respecting the enormous velocity which is ascribed to the transmission of telegraphic signals. The experiments just noticed afford some information upon this point. They furnish the means of measuring the velocity of the electric fluid; provided the time employed in its passage from Jersey City to Washington, is not too small to be appreciated. Suppose the difference of longitude between the two places is exactly twelve minutes. Accordingly, when it is ten o'clock at Washington, it will be twelve minutes past ten at Jersey City. Let now a telegraphic signal be given from Jersey City. If that signal is heard at the same instant at Washington, then the Washington clock should indicate exactly ten hours. But if it requires one second for the signal to travel to Washington, then upon its arrival the Washington clock will indicate ten hours and one second; that is, according to this comparison, the difference between the Jersey City and Washington clocks will appear to be *eleven minutes and fifty-nine seconds*. Suppose again, that at ten o'clock a signal is given from Washington. If that signal is heard at the same instant at Jersey City, then the Jersey City clock should indicate exactly twelve minutes past ten; but if it requires one second for the signal to travel from Washington to Jersey City, then upon its arrival the Jersey City clock should indicate ten hours, twelve minutes, and one second; that is, according to this comparison, the difference between the two clocks appears to be *twelve minutes and one second*. The two comparisons differ by *two seconds*, or twice the time required for the signal to travel from Jersey City to Washington. Now, whatever may be the time required for the transmission of a signal, the difference between the two modes of comparing the clocks should amount to *twice* that interval, and the longitude derived from signals transmitted from Jersey City to Washington should be *less* than that derived from signals transmitted from Washington to Jersey City.

What now is the result of the experiments actually made? The longitude derived from the two modes of comparing the clocks do really differ. The difference amounts in some cases to one-third of a second. But, strange as it may appear, this difference is in the wrong direction. The longitude derived from signals transmitted from Jersey City to Washington is greater than that derived from signals transmitted from Washington to Jersey City. The conclusion seems to follow, that a telegraphic signal is transmitted more than two hundred miles in less than no time. Observe that we now speak of absolute, not local time; for it is not doubted that a signal made at Jersey City at ten o'clock will reach Washington long before ten according to Washington time. But the observations seem to indicate that a signal from Jersey City is heard at Washington before it is made at Jersey City; and also that a signal from Washington is heard at Jersey City before it is made at Washington. Such a conclusion will suit poetry better than science. It seems probable that the difference in question arises from the difficulty of estimating minute fractions of a second. This is indicated by the fact that, on one evening, the Jersey City and Philadelphia clocks were found to tick together; and the signals being given coincident with the beats of one clock, the times of arrival coincided with the beats of the other clock. Thus there was no fraction of a second for the ear to estimate, and the two modes of comparing the clocks gave identical results. On several evenings the discrepancy in the observations amounted to about *one-third of a second*; and if we suppose each observer to err in his estimate by *one-sixth of a second*, the difference is explained; only we must admit that each observer, upon the arrival of a clock signal, estimates the time one-sixth of a second *too soon*; which *seems* to indicate that the signal is heard at a distant station before it is really made.

That this hypothesis is not without foundation has been verified in the following manner: — The three observers, Messrs. Loomis, Walker, and Keith, have met at Jersey City, and compared their methods of observation; more especially their modes of estimating fractions of a second. This was done by comparing solar time with sidereal time. The solar day is about four minutes longer than the sidereal; and a sidereal clock will therefore gain upon a solar clock, one second in about six minutes. A series of signals was transmitted from Jersey City to Philadelphia, at intervals of ten seconds; coincident with the beats of a solar clock, and the times recorded by Professor Kendall at Philadelphia upon a sidereal clock. The times were also recorded at Jersey City by a sidereal clock. These signals were continued for ten minutes, during which time the sidereal clock had gained more than one second upon the solar. The signals being all given coincident with the beats of a solar clock, the fractions of a second estimated upon the sidereal clock go on continually increasing, and pass through every possible value in about six minutes. In a period of ten mi-

nutes, the clock-beats must twice coincide. Now the ear can judge of a *coincidence* of beats with almost absolute precision; and having determined the instants when the beats coincide, we can easily compute what fraction ought to have been estimated upon the sidereal clock at each signal from the solar clock. Thus we obtain the error of each estimate of time on the sidereal clock. A similar set of signals was given at Philadelphia from a solar clock, and received at Jersey City upon a sidereal clock. The result of these trials was to detect a small error in the estimation of fractions of a second; and such as will explain in part, if not wholly, the discrepancy of the observations.

One important conclusion is deducible from these experiments, viz., that by means of the magnetic telegraph, *a clock in New York can be compared with another at a distance of two hundred miles quite as accurately as two clocks can be compared in adjoining rooms.* Another conclusion which appears to be authorized by these experiments is, that *the time required for the electric fluid to travel from New York to Washington and back again, a distance of 450 miles, is so small a fraction of a second, that it is inappreciable to the most practised observer.*

THE CRICKET STEAM-BOAT EXPLOSION.—THE VERDICT.

The Inquest Jury returned, late on Friday (24th,) after our Number for last week had gone to press, the following verdict:

"We find that Thomas Shed, John Littleton, John Blunt, George Shute, and John Buckley, came to their deaths through the bursting of the boiler of the *Cricket* steam-boat, on the 27th of August, 1847. We find a verdict of manslaughter against Henry Robert Heasman. We consider Thomas Clark highly culpable, and unfit to hold a situation of engineer. We likewise consider Mr. Smith's conduct shamefully neglectful in not properly investigating the complaint made against Clark."

Heasman, who has been found guilty of manslaughter, is the engineer who was in actual charge of the *Cricket* on the morning of the explosion; Clark was the general engineering superintendent of the A. B. C. Company's boats.

ADCOCK'S SPRAY PUMP.

Sir,—A correspondent, who signs himself "Cassell Morlais," writes on the subject of Mr. Adcock's Spray Pump; and he dates his letter from Merthyr Tydvil, one of the largest sites of the iron manufacture.

Now, Sir, I wish to know whether he be acquainted with the processes of the iron manufacture; and with blast cylinders? If so, he must, for some object best known to himself, have written his letter expressly with the view to deceive your readers.

He informs us, that Mr. Adcock employs a blast cylinder 48½ inches diameter; and then states, that such cylinder is equal to 54 horses power!!!

Is "Cassell Morlais" aware that it is always customary in the iron trade to make the blast cylinder twice the diameter of the steam cylinder? A 48-inch blast cylinder, therefore, would take a 24-inch steam cylinder! And is "Cassell Morlais" aware, that a 24-inch steam cylinder is 20 horses power? How, then, does he make it 54 horses power?

The fact is, Sir, the very blast cylinder now working at Llanhithel was worked, in this neighbourhood, to 4lbs. pressure, by a 28-inch low-pressure condensing engine,—which is not half the power stated by "Cassell Morlais;" and as the engine had been employed as an old "*Whimsy*," to wind up coal from a pit, it did not work to the power that an engine of that sized steam-cylinder should do.

I know nothing of "Cassell Morlais's" other figures; but in the one under consideration, there is an error of nearly three to one. I am, Sir, yours, &c.,

"FAIR PLAY."

Birmingham, Sept. 16, 1847.

[We have reason to suspect we have been made, unconsciously, the instruments of a wicked conspiracy to depreciate Mr. Adcock's invention by the publication of *wilfully* erroneous statements which have been sent to us with names and addresses having all the appearance of reality, but which are, in truth, entirely fictitious. Who, for instance, is the "J. Phillips" who last addressed us on this subject from "Greenwich?" No such person is known at the Greenwich post-office. ED. M. M.]

Mr. Stephenson's Long-bodied Locomotives.

The inquest on the body of the engine-driver, Gregory, who was killed last summer on the London and Brighton Railway, by the running of the engine he was driving off the rails, has been only this week concluded. The verdict is in the following terms:

"That Samuel Gregory, on the 31st of May last, was killed by the engine No. 40 running off the line of the London, Brighton, and South Coast Railway, in the parish of Westbourne, in this county; that such engine was subject to considerable oscillation, which gave it an undulating, swaying, and jumping motion, but whether the engine left the rails in consequence of such motion, or from what other reason, no evidence appears to us."

Captain Allen (the foreman).—In addition to this verdict, the jury also wish to recommend to the Directors of the London, Brighton, and South Coast Railway, that they should not in future use this description of carriage upon the railway.

Mr. Faithful.—These engines are now no longer used for passenger trains. (Hear, hear.)

A Juryman.—The public will be glad to hear it.

LIST OF ENGLISH PATENTS GRANTED FROM SEPT. 24, TO SEPT. 30, 1847.

Charles Jay, of Bathurst-street, Hyde-park Gardens, Middlesex, gentleman, for certain improvements in apparatus for evaporating and concentrating saccharine and saline solutions, and which may be also applicable to the evaporation and concentration of vegetable and other extracts. Sep. 30; six months.

Thomas Moore, of Burnley, Lancaster, manufacturer, for certain improvements in looms for weaving. September 30; six months.

William Edward Newton, of Chancery-lane, Middlesex, civil engineer, for improvements in machinery for the manufacture of nets and netting. Sept. 30; six months.

Richard Johnson, of Manchester, wire manufacturer, for certain improvements in the manufacture of wire cloth. September 30; six months.

Charles de la Sabzeae, of Paris, gentleman, for improvements in brassing and bronzing the surface of steel, iron, zinc, lead, and tin. September 30; six months.

Robert Hawkins Nicholls, of Thurlby-grange, Bourne, Lincoln, gentleman, for improvements in machinery for distributing corn and other grain on land, and also improvements in giving motion to agricultural and other machinery. September 30; six months.

Ignacio de Barros, of Lisbon, gentleman, for improvements in machinery for making lasts for boots and shoes, butts or stocks for fire-arms, and other irregular forms. (Being a communication.) September 30; six months.

LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED UNDER 6 & 7 VIC. CAP. 65.

Date of Registration.	No. in the Register.	Proprietors' Names.	Address.	Subject of Design.
Sep. 25	1206	William Devey and Son	Shoe-lane, brass-founders	Tap or cock.
27	1207	Eugene Boileau	Grove-road, Mile-end	Caligraphic type.
,,	1208	John Moore Hyde	Bristol, optician	Submarine communicator.
,,	1209	David Moseley	Chorlton-cum-Medlock, Manchester	Machine for lapping card-fillets upon the cylinders used in carding cotton and other fibrous substances.
,,	1210	Thomas Wharton	Birmingham	Victoria Taper.

l working purposes, and decidedly eco-

Haslingden, September 4, 1847.
-We have now been using the Gutta
s for the last eight months, and have
re in saying they have answered our
ne expectations; and we may add, that
machines which required a 12-inch lea-
and which almost daily required to be
have been turning the same with the
a Straps 10 inches only for the above-
d, and now find them as good as the
re first applied.
Ve remain, yours respectfully,
W. & R. TURNER.
ham, Esq., Gutta Percha Company.

as Works, Manchester, Sept. 1, 1847.
eply to your inquiry as to the result of
nce with the Gutta Percha Straps, we
leasure in stating that the advantages
are so very manifest as to induce us to
in almost every instance where new
quired.
Ve are, Sir, very respectfully,
SHARP, BROTHERS.
tatham, Esq., Gutta Percha Company.

Bridgewater Foundry, Patncroft, near
Manchester, Sept. 3, 1847.
eply to your inquiry respecting how we
atta Percha Machine Straps or Driving
ugh we have not had quite so much
in the above-named use of Gutta Percha
to have, so far as we have employed it,
us general satisfaction. The beauti-
nt and regular manner in which it runs
eys, especially on our cone or speed pul-
rong recommendation in its favour; and
e are inclined to think it does not take
p on the pulley as leather, yet there is
for all general purposes. We shall con-
it and to give it our best attention, so
how to employ to best advantage the
lent qualities it possesses over the ordi-
r belts.
NASMYTH, GASKELL, & CO.
m, Esq., Gutta Percha Works, London.

Manchester, 18th June, 1847.
—We beg to inform you that we have
e patent Gutta Percha Bands or Straps
nore than six months. For tube frames
r them very much superior to anything
ried before. They also do very well as
for mules, throstles, looms, &c.
, Sir, yours respectfully,
THOS. DODGSHON & NEPHEWS.
uel Statham, Gutta Percha Company.

Wellington Mills, Stockport,
4th September, 1847.
en,—We have much pleasure in bearing
ony to the valuable qualities of the Gutta
driving bands. We have found it answer
y well in most cases where we have tried
think it has only to be made known to
very general use.
Gentlemen, yours obediently,
OLE, LINGARD, & CRUTTENDEN.
utta Percha Company,
ty Road, London.

ottington Hall, near Bury, Lancashire,
September 3, 1847.
,—Your letter of the 31st August is to
in answer respecting the use of your
cha Bands, I cannot give you a better
r approval of them in preference to lea-
than having given an order for another
tner, yesterday, to be in readiness in case
t. They are decidedly preferable to the
; and we can recommend them with the
nfidence to any person for Driving Straps.
ALL & GORTON, THOMAS GORTON.
am, Esq., Gutta Percha Company.

Brewery, 16th September, 1847.
Gentlemen,—We have much pleasure in repeating our testimony to the very great improvement effected by the use of Machinery Bands made of your material instead of leather: the stoppage of parts of our works, through the failing of the leather straps, used to be of daily occurrence, causing great inconvenience and expense. With this annoyance we are now never troubled, and are assured by our superintendent that the advantage of using your material is surprising, as regards economy and saving of trouble. We confidently recommend it to machinists and factories for general adoption.
TRUMAN, HANBURY, BUXTON, & CO.
To the Gutta Percha Company.

Gutta Percha Soles for Boots and Shoes.

The capabilities of the GUTTA PERCHA SOLES FOR BOOTS AND SHOES having been extensively and satisfactorily tested, we can unhesitatingly recommend the material prepared for the purpose, its merit having been acknowledged by all who have worn it. Indeed, experience has proved that Gutta Percha Soles wear twice as long as leather, with great additional personal comfort, and they remain perfectly impervious to wet until quite worn through.

23, Southampton Row, 1st Sept., 1847.
Gentlemen,—I write to thank you for allowing me to use the new PATENT GUTTA PERCHA SOLES. I felt annoyed at not being allowed to use them from the time I had first worn them, namely, from last October, but am not sorry now, because I can speak confidently of their advantages over leather soles. I made the first pair last October, and wore them eight months before I wore the soles through. I had them heeled six times, and one pair of extra fronts I put to the same soles. *I only kept the one pair in wear to see how long they would last.* I will never wear another leather sole so long as I can get GUTTA PERCHA SOLES, and I walk from 12 to 20 miles a day.
C. WRIGHT, Boot and Shoe-maker.
To the Gutta Percha Company.

9, Gloucester Row, Hoxton, 5th July, 1847.
Sir,—I beg to thank you for the boots with GUTTA PERCHA SOLES which I had from you on the first of the year. I have had them in constant use for nearly five months, the greater portion of that time being the most inclement period of the year; and from my occupation as a general post letter-carrier, you may be sure that they have had more than a common fair trial, and the Gutta Percha seems now as firm and as little worn as on the first day.
W. HUTTON, G. P. O. Letter Carrier.
To E. Granville, Esq., Gutta Percha Works.

28, St. John-street, August 25th, 1847.
Gentlemen,—It gives me great pleasure to acquaint you that the Gutta Percha Soles I had from your Works have answered the purpose admirably, as I can fully testify, having had them in wear six months, during the winter, in Smithfield-market, and have not been subjected to the annoyance of wet feet, as is often the case with leather soles, and, in my opinion, they wear three times as long.
H. I. TARLING.
To the Gutta Percha Company.

N.B.—The above Soles, which are not worn out, may be seen at the Gutta Percha Company's works.

Galoshes, Tubing of all sizes, Bougies, Catheters, and other SURGICAL INSTRUMENTS; MOULDINGS FOR PICTURE-FRAMES and other decorative purposes, WHIPS and THONGS, TENNIS, GOLF, and CRICKET BALLS, are in a forward state of manufacture, and will be very shortly ready for sale.

All orders forwarded to the COMPANY'S WORKS, WHARF-ROAD, CITY-ROAD, will receive immediate attention.

CONTENTS OF THIS NUM

NOTICE TO CORRESPONDE

"The *Times* and Steam Printing." *received, but at too late a period of the sertion in this Number, a copy of an a will appear in the October number of the* cal Magazine, *by the editor, Mr. Rich containing some comments on our article ject. We think it right to state gene meanwhile, that Mr. Taylor shows cle that Mr. George Woodfall, Mr. Bensley, were the first efficient patrons of Kœnig, share of the proprietors of the* Times *i duction of steam-printing was but, to Mr. Walter's own words, " the applic discovery, under an agreement with the our own particular business."*

C. B. M. — *" Alarm " is the prop Alarum is a vulgarism.*

N. G.—Desaguliers was of French ext kept a French school in Islington, but phical works are in English, and it has b rank him as of the English school of phil

The " College for Engineers," and the " College," are two very different things. real college, having a body of noblemen men for its patrons, and men of high sci for its professors; the other is a college sense only that the " Three Tailors of To represented, " All England"—with this tion only, that here there are two *instead*

Erratum.—Page 280, col. 2, line 44, f tion" *read* " formula."

Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 1261.] SATURDAY, OCTOBER 9. [Price 3d.

Edited by J. C. Robertson, 166 Fleet-street.

ROCK AND SONS' DUPLEX CHARIOT.

Fig. 1.

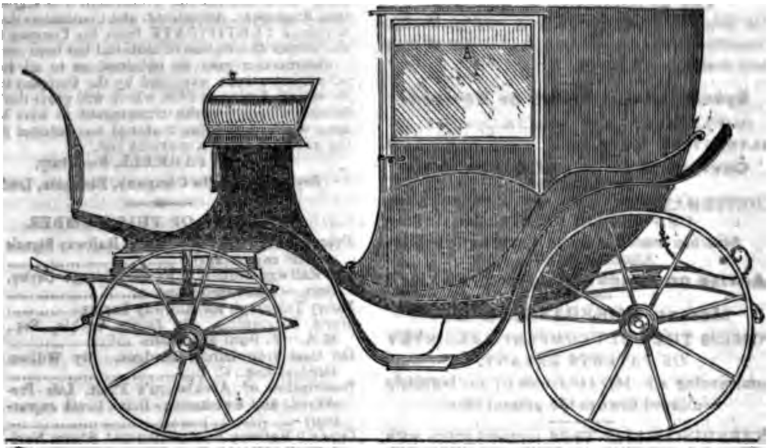


Fig. 2.

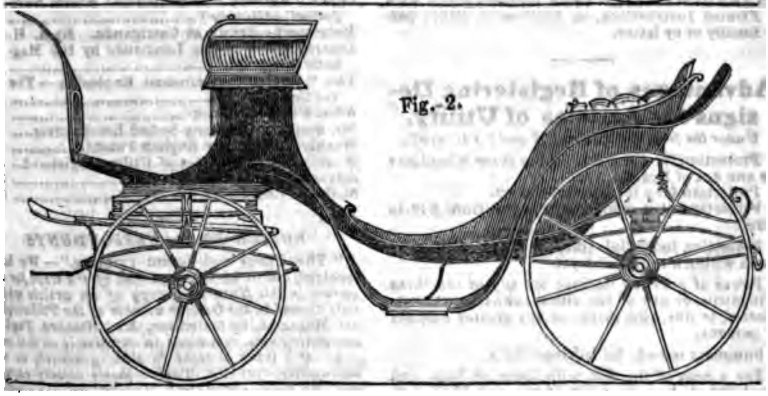
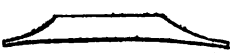


Fig. 5.



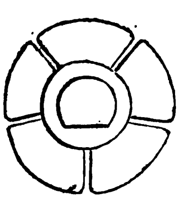


Fig. 6.

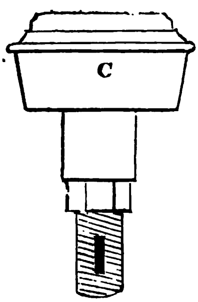


Fig. 4.

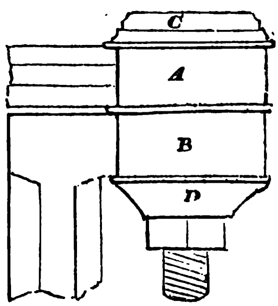


Fig. 3.

MESSRS. ROOK AND SONS' DUPLEX CHARIOT.

[Registered under the Act for the Protection of Articles of Utility.

HASTINGS seems destined to acquire a celebrity for carriage-building not often approached out of the metropolis. We have seen nowhere more elegant or convenient equipages; nor anywhere more originality and variety. We refer more particularly to a class of carriages called *carioléts*, and to the two best of that class, namely, the open double-seated briska, convertible in a minute or two into a close family coach fit for court or country, and the little safety pony-chaise for two, possessing all the dash of the curricle with as much facility of mounting and alighting as the very handy but ugly Irish jaunting-car. The vehicles we speak of are the invention of Messrs. Rook and Sons, of Hastings, who have acquired great local fame for their taste and skill in this branch of business.

The figures prefixed to our present Number represent one of the latest productions of these gentlemen. It is called a "Duplex Chariot," from the circumstance of the upper part of it being detachable from the under, and serving in the one state as a close carriage and in the other as an open one (By means of a counterbalance and a cord, running over two ro tached to the ceiling of the coach the whole of the upper part, togetl the doors, is removed in one piece, the lower part without any indic the severance it has undergone. remains suspended to the cei wanted, when it is lowered to it with as much ease as the shutting c window. Four screws are then i and the carriage becomes a close o

Some of the details in the c tion of this carriage are deser notice. The springs are of an form, and the bolts instead of b serted loosely, as usual, are of and close-fitting description rep in fig. 3. A, is the collar-stay; lower-stay; C, a solid bolt (sh tached in fig. 4,) which is pass through B. D is a spring colle form separately shown in plan tion in fig. 5 and 6.

THE NEW BUILDING AT BUCKINGHAM PALACE.

We may be excused for stepping a little out of our usual and proper track, in order to make ourselves the organ of opinion on a question of some moment concerning one branch of art—one which is in many respects intimately connected with, and materially dependent upon, scientific and mechanical skill, on the advance of the former and the improvements made in the latter. Perhaps we should not have touched the question at all, but for the apathy or timidity of those to whom it properly belongs, and who, with just one or two exceptions, seem determined to stifle it, notwithstanding that they affect to watch, both paternally and patriotically, over art, in all its bearings and all its interests. Whether there be not a good deal of hypocritical cant—at least of sheer affectation—in what is said as to promoting "high art," and diffusing a taste for it throughout the community, is what we shall not here inquire; let it suffice to say, that the palace strongly contradicts the notion of such views being entertained consistently. Wherefore, we know not, but the design for the new Park façade to the palace did not, it seems, fall within the jur of the "Commissioners on tl Arts"! Still, it is strange hov design—and we have heard but nion in regard to it, that of deci demnation—could have quietl through both Houses of Parliamen out incurring so much as a single strance. This unhappy acquies not the less to be deplored becau have been occasioned by ill-tin too scrupulous delicacy, and wh throws all the odium of paltry ta a quarter that ought to have been from it, more especially after th reflections that have been cast up low taste of George IV." As it i of complaisance has sadly comp royal taste; yet without critici design submitted to them "by command," Parliament migh have recommended, that there sl a public competition similar to their own edifice, in order that ideas which could be had mig been obtained. Or, rather, M himself ought, in the very first i to have strongly urged the pro

ıode of procedure; as he might ıe with perfect safety to his own because it might have been sti- that, as the official architect to .ce, he should be employed to the adopted design, its author munerated by a handsome sum -he would then have fully shel- nself from blame, and, by fore- l claim to architectural author- ›uld have escaped, as we now d are sorry to say, very heavy rious architectural disgrace.

g as Buckingham Palace remain- ched, it could be pointed to with ıall feeling of satisfaction, as ng a certain advance made by he better, in architectural taste time of its first erection; whereas : only is there a relapse into all inal littleness and triviality of but the sort of distinction which lee derived from the space in it between the wings, with the ırch in advance of the general ıe buildings, is forfeited. Owing ing brought out so very much ır—about seventy feet—the new is thrust almost immediately › public road in the Park, in such that it will have very much the ›eing nothing more than one of nges of private houses combined up a lengthened façade, which fashion for speculators to dub a It will have precisely such un- ; *infra-dig.* physiognomy, and : nothing so much as five such hree of which are three windows th, and the two intermediate ones ch. Except that the material is ıtead of stucco, the architectural ises hardly at all above the kind n that may now frequently be ome of the newly-formed streets; ing very little if any more study ,—and, of invention, not quite so we occasionally perceive in the re and there thrown out in the :hitecture just alluded to. While : of decoration is but of a very ate and second-hand sort, marked ɔness as well as pert showiness, arts and features are very insig- There are by far too many for dignity of composition; : the centre and end compart- ɔok actually squeezed together, the expression given to the exterior indicates no more than a number of moderate-sized rooms within,—probably only for increased domestic accommodation, the necessity for which was represented so pathetically by Mr. Blore in his Report on the Palace. Whether such be really the case, we are unable to say, because, although the officially-published designs profess to be "Plans and Elevations," there is not so much as a single drawing among them answering to the first description. In fact, there are only three plates—two elevations and a perspective view; nor do they seem to have been at all revised or collated; for, on comparing them, several discrepancies will be found between the geometrical drawings and the perspective one—which is certainly false in one material respect, inasmuch as the Park front, which will be almost always in shade, is represented with the sun full upon it, consequently shown to the utmost advantage, while the south side, which is a mere architectural farrago, is more judiciously than truthfully concealed by being thrown into shadow. Had Mr. Blore considered for a moment that his façade would have the disadvantage of an east aspect, he would probably have endeavoured to overcome that very unfavourable circumstance, both by boldness of outline, and by giving such relief to various parts of his composition as would in a great measure have made up for the absence of positive light and shade. He might have done much more, since by shaping his plan accordingly, he might have produced a very powerful degree of picturesque effect, by admitting the light from behind through one or more colonnaded openings, as the case might be, in the façade, after the manner of the two open loggias in the terrace front of Somerset-place. A central colonnade over the ground-floor, forming a terrace-garden on the level of the principal floor, would—if executed on a majestic scale, not with such a puny order as the portico within the court—have been attended with strikingly scenic effect in whichever direction it was viewed. As seen from the apartments around the court behind it, it would have shown itself admirably, and have admitted a peep through its colonnades into the Park; whereas now those rooms will be entirely deprived of the cheerful prospect hitherto presented to them; which will most assuredly be

the reverse of improvement as far as they are concerned. As regards the external façade, an open colonnade of the kind here hinted at, would have imparted piquant vivacity and expression to the whole. Of course, it would have been necessary to prolong the façade in order to make up for the space occupied by the centre opening; but that, too, would have been an advantage, not only by producing greater extent of front, but also by screening the rest of the building, especially the south-side of it, with which the portion now added does not connect itself it all; on the contrary, shows itself to be stuck on in the most awkward manner. Again: had the façade been prolonged—carried out as far as the two diminutive Doric wings, which are left standing, now are—the extremities might have been about a story lower than the rest; which would have produced variety of component masses.

Matters were managed cleverly enough in one respect. By ensuring as much secrecy as possible, the works were commenced before there was time for the public to inquire into, or even ask, what was about to be done. Urgent indeed must have been the necessity that occasioned such unfortunate precipitation, the consequences of which are now likely to be felt rather severely in the shape of very ungracious criticism, and not particularly loyal reflections upon royal taste—at least, on the ability of those in whom, perhaps, it too implicitly confides. The only excuse we can suggest for Mr. Blore, is, that he was so hurried, as to be bewildered as well, (no uncommon case with men of small mental calibre)—had no time to arrange his ideas, but was driven to take up with the first crude and common-place thoughts that occurred to him, notwithstanding it may be supposed that he must have had reason to contemplate such occasion for his services—must have been warned of the "coming event" by its forecast "shadow." Or, did he trust to there being, as a matter of course, a public competition—more especially as buildings of infinitely less importance than a Royal palace are now-a-days made subjects of architectural rivalry? If such really was his hope and assured trust, we may indeed pity him; nevertheless, we cannot help debating with ourselves, whether this might not be as fit occasion as any for putting into practice D'Israeli's shrewd, though stern to "hang an architect" now an by way of wholesome warning profession. Indeed, to speak th our chief ground for hesitation point of "*high* art" is, that we hang up both architects at once John Nash, who having the opp to make of Buckingham-*hous* LACE worthy of the country, le but a house a little less ugly than and Edward Blore, who has blo of view all that was new and goo embellishments of his predeces restored the edifice to its pristi ness and mediocrity. It might, shock public feeling too much t but one of two equally flagrant of more especially as public feeling ting squeamish about hanging al —whether in ones or twos. If, h such a thing as hanging *by effi* only to come into vogue, we sho ously recommend that effigies and Blore should be suspended f highest points of the outermos of Buckingham Palace; nor sh object, for the sake of completen an effigy of George the Fourth sl tailed to that of Nash, to show influence *he* (Nash) is said to ha *weighed down*.—(*See* Professor son's Maxims.) Whether any the shape of an effigy in pettic tached to that of Blore, would m picture of "Justice satisfied" st complete we have no idea. Perh Blore may have some very distir upon the subject; if so, let hin out and "shame"—Pshaw! almost forgot that it is a *Queen* "on the throne;" a Queen who, r standing her alleged want of sy for native genius, is still a shini to the other sovereigns of the ea wants only, we fancy, to be instr what is right, in order to WI COMMAND IT.

ON THE EMPLOYMENT OF HEAT MOTIVE POWER. BY A. H

Sir,—There is, at the present m no question of such great and p interest, both practical and thec as that relating to the use of h motive power. The inquiry is which already much has been d the labours of the most able menters, such as Gay-Lussac, D

vell as a vast amount of expe- ;en accumulated by the daily ob- ns of practical men. Everything ng the economy of fuel, the use of :c., in, olves so many manufactur- :ests, and affects men's pockets so that it is no wonder it has com- , and always will command, a of attention which perhaps no hysical problem is likely to do. ars to me that mathematicians t contributed their share to this It is true, that to frame any- :e a useful and productive *me- l* theory of heat, would require iest efforts of the most consum- athematician living, and after all, sibly exceed the present powers sis: but, without going thus into *à priori* investigation — there be yet a possibility of getting a al more out of the facts and no- already possess, than has hitherto :ained. There are some "second- iciples (as they have been termed) iich all the fruits they are capa- aring have not yet been gathered. :ct of this paper is to refer to these principles, and especially the attention of those of your who are in the habit of applying atics to physical problems, to a which can hardly fail to reward ours: and also, at the same time, briefly the manner in which the bears upon the practical questions :conomy of power, to which so ire is now being given.

nutual convertibility of heat and cal power is only one instance of il law. Under the title of "Cor- of the Physical Forces," Pro- rove, of the London Institution, :ribed, and neatly illustrated the :onvertibility of electricity, mag- chemical force, and motion. This bility of one into the other is of daily and hourly observation, :ourse has attracted the attention rimenters more or less from the periods. (Those who wish to subject systematically entered ill find the pamphlet by Mr. with the above title, extremely ng.) So long, however, as our ge is confined to the mere vague it, that one of these is converti- the other—without any definite ge of *how much* of one is required to produce so much of another—so long must the theory, however beautiful in its generality, remain barren of everything like accurate results. The knowledge that electricity produced magnetism led Faraday to suspect, and then, by experimenting, to find out, that magnetism produced electricity. So far the general theory is valuable as a *suggestive one*. But in such a case as that of heat and mechanical power, we have for centuries been far beyond this point. The first man who saw the lid of his kettle blown off by steam, had learnt that heat is convertible into mechanical effects, and he who ignited wood by rubbing two pieces violently together, was a witness to the convertibility of mechanical power into heat. What we want *now* is, *the numerical relation between the two*. To obtain such a relation, we must, of course, be able in the first place to *measure* each of these two things separately, before we can compare one with the other; we must have some mode of measuring different quantities of heat, and also different quantities of mechanical power. Now, with regard to the latter, we know that it can be measured in more ways than one, as for instance by *pressure* as well as *velocity*. The two *measures* are connected, it is true, by what is termed the third law of motion: but still the two measures refer to *different effects*; effects differing, too, in the mode in which they affect our senses. We nevertheless consider either of these effects as a fit exponent of the same primary action: in whatever way *pressure* be caused, or *velocity* be produced, we consider both as the manifestation of one and the same cause: we have obtained however a relation between the two, which enables us, when we know the amount of one, to calculate the amount of the other. Pressure (one effect) being known, we can find the corresponding amount of velocity (another effect, and one differing in the way it affects our senses.) Now these two effects,—pressure and velocity,—are quite as *different in their nature* (if degrees of difference be an admissible expression) as *heat and mechanical action*. What, then, is to prevent our attaining a similar relation between *these two* effects? If, in the one case, we have been able to obtain a numerical relation —and one upon which a mathematically

rigorous science, namely, dynamics, can be built--why not in the other? Observe, however, that in the first case, before being able to compare numerically the different effects,—pressure and velocity,—we were able *accurately to measure each.* Therefore we must, in the first place, and before we can go one step onward, be able to measure *heat.* Now, just as mechanical action shows itself in the two forms of pressure and velocity, so does heat show itself in expansion and increase of pressure, or since expansion is in reality motion, we have here the same two effects as in mechanical action. It would be easy to show in the same way that electricity, magnetism, and chemical action, do each of them exhibit themselves in the same two forms, viz., of pressure and motion: with these, however, we have at present nothing to do. Take any of the great physical agents then, and not only have we daily observation of one passing into the other, but each of them exhibiting itself as pressure or motion. As "pressure" may be expressed in terms of the *quantity of matter* put in motion, and the *velocity of* that motion, we conclude therefore, that every physical agent with which we are acquainted is thus resolvable into the same ultimate elements, namely, quantity of matter and velocity, with which that matter is in motion. Those who adopt Boscovick's theory will of course go still further, and reduce finally every physical effect to simple differences of velocity—or rather (since they suppose no material particles to exist, and therefore no such thing as velocity in the ordinary sense of the word) to different degrees of energy in the "centres of force" which they suppose. As I cannot give up my belief in "matter," I rest at the point above mentioned, and regard every phenomenon of whatever kind or name, as simply arising, and ultimately consisting in differences of the quantity of matter put in motion, and differences in the degree of velocity with which such matter is put in motion. Consequently, every phenomenon, whether chemical or electrical, admits of the same mathematical calculation as any astronomical fact—and no doubt time only is required to obtain such knowledge.

To return, however, to the subject of heat. All the circumstances connected with it, so far as they are capable of being observed and measured, may be classed under the heads,

(1.) Expansion of the body or substance experimented upon.

(2.) Expansion of the mercury in the thermometer, or in other words, the temperature of the body.

(3.) Pressure exerted against any obstacle which resists such expansion in the body.

(4.) Change of state, as from solid to fluid or from fluid to gas, which change is but one stage or step in the expansion.

(5.) The amount of heat consumed or required to produce the above effects, which amount receives, under different circumstances, the names of latent heat and specific heat; the former being the index of the force required to change the state from solid to liquid or liquid to gas; and the latter being the index of the force required to expand the mercury of a thermometer through one degree, according to the substance it is in contact with.

Between these various effects we require the numerical relations, just as in mechanics we have to find the relation between pressure and velocity. The first four of the above-enumerated effects are obviously, in fact, of the same kind as the effect in ordinary mechanics—expansion being motion. "Latent" and "specific heat" are also each of them merely terms for a certain expansion of mercury under given circumstances. We have nothing more to do with any occult or *à priori* cause in this subject than we have in mechanics. Those who choose to believe in an unknown fluid, and call it the substance or matter of heat, are just in the same predicament as those who, in the days of Newton, must needs bother themselves about "what gravitation consisted in." Certain facts being known, plain to the senses and measurable by instruments, and their *law* being known,—as, for instance, that two masses come together with a velocity proportionate to the masses and inverse space of the distance,—everything is known at all necessary towards constructing an accurate mathematical science, useful for the practical purposes of life, and, *so far as it goes,* perfectly satisfactory to the intellect. Whatever, however, may be the antecedent circumstances of which the ordinary phenomena of heat are the consequences, there are certain secondary

laws suggested by a general review of physical science, and especially that branch of it in which we possess the clearest notions, viz., mechanics, which may guide us in the investigation. This investigation has for its object to obtain numerical relations between the quantities above mentioned. Already have several such relations been found out by experiment, the laws of Boyle and Mariotte, of Gay Lussac, of Dulong and Petit, &c., for example; but there still remains much that is unknown. The connection between the pressure and temperature of common steam, for instance, which, although represented by empirical formulæ derived from a limited number of observations, so as to afford some practical information, ought to be given at once in the terms of a general law, before we can be said to have anything like a satisfactory knowledge.

The problem which the practical man has before him, may be illustrated perhaps thus:—He has a certain amount of heat which he wishes to turn into mechanical power. Not being able to do this *directly*, or, rather, this not being expedient, he is obliged to employ some intermediate agent. It is required to find what substance should be chosen, in order that the transfer may be effected with the least possible loss. The series of operations, from the primary to the final terms, may be arranged in a series or diagram:

Chemical Action, as Union of Carbon and Oxygen, } or heat.	Intermediate Agent, as Expansion of Water.	Mechanical Power, as Moving Piston.
(A).	(B).	(C).

Having chosen the materials for the first term—in which, of course, he may employ any bodies which have a chemical attraction for each other, and is guided by considering which are the most easily procured or cheapest, and at the same time have the strongest mutual attraction, and both of which qualities are more plentifully found in coal and common air than in any others at present—he has next to select a substance to perform the office of transferer, or intermediate agent (B). For this he might take a bar of iron, and by the expansion of this bar, which is accompanied by a tremendous pressure, might obtain at once his object in many cases, as in fact has been done. Or, again, he might take a mass of common air, and by its expansion obtain his end. In either of these cases there is no *change of state* in the substance thus used. The iron remains solid, and the air remains aëriform. But the substance which is almost universally chosen is water, and the mechanical power obtained by the expansion of that water into steam. Here then occurs the question: Is there, or is there not any loss of useful effect incurred by using an agent which changes its state from liquid to gas during expansion?—Is there any power absorbed during this change, and not given out again?—Is there any force overcome *uselessly?* If so, there is a loss of just so much money—money expended in overcoming resistances and doing things which it is not our object to do, and which are not necessary in order to that which we are aiming at. This question is obviously one of the greatest importance, and will require careful consideration. Whenever an enormous pressure is required, but only to act through a small space, the expansion of a solid, as a bar of iron, may be used, or, which amounts to the same thing, the contraction of such a body in cooling. In fixing on the tires of wheels, and in many other such operations, this is the usual method of converting heat into mechanical action. But wherever the pressure is required to be exerted through a considerable space, either the dilatation of a gas, or of a fluid into a gas, is that to which recourse is had. The expansion of air or gas is so far of the same nature as the expansion of a bar of iron or other solid, that no forces are called into play by *a change of state.* In the conversion of water into steam, however, there are such forces exerted, and we have to determine, amongst other questions, whether in combatting them any of the useful effect is absorbed which is not afterwards restored? Between the particles of water there are certain unknown attractions, by which the liquid form is preserved, and which must of necessity be overcome by the heat in converting the water into steam. But at the moment when the steam itself is formed, since, like common air, the particles of steam repel each other, we no longer have a set of internal forces *opposing* expansion, but, on the contrary, we have such a set *assisting* and increasing that expansion.

At some intermediate point, therefore, attraction ends, and repulsion begins. Add together the elements of "work done" during the first part of the process in overcoming resistance to expansion, determine next the amount of the repulsive energy which favours expansion, and according as one or the other of these sums is greater, so will there be a loss of useful effect or an increase by employing water as the intermediate agent to transform chemical action or heat into pressure and motion. The difference also between the two sums will be the gain or loss. In attempting the solution of this, as well as of all other problems in this subject, the following principle (one of the *secondary* principles to which I have previously referred) may, I believe, be used with the most perfect confidence. A given quantity of heat (that, for instance, obtained by the consumption of a ton of coal) is in all respects, and under all circumstances, equivalent to a certain pressure or resistance, R, overcome through a certain space, S. Whether the effects of the heat manifest themselves in the expansion of a body without change of state, in the conversion of a liquid into a gas, or in dilating the mercury of a thermometer—under these and all other circumstances may the preceding proposition be affirmed.

We have now to show how any and all of these different sorts of effect may be expressed in similar terms—namely, as a certain pressure overcome through a certain space; in short, as "work done." Some of these effects are obviously already in that form. To take a simple instance of such; suppose 1,000 cubic feet of atmospheric air enclosed in a cylinder, the piston being loaded with a constant pressure: by the application of heat let this be expanded from 0° to 100° of the Centigrade thermometer, or from 32° to 212° of Fahrenheit.

According to the well-known experiments of Rudberg and Regnault, the 1,000 cubic feet will become 1,366, the pressure on the piston remaining constant, and = P pounds suppose. Therefore, here we have at once a mechanical effect, = P pounds raised through 366 feet, or 366 × P pounds raised one foot. Another case is where we have a mass of air or other gas confined in a given space, and not allowed to expand, whilst heat is applied to it. Here there is a constantly-increasing pressure on the sides of the containing vessel, and the sum of all the pressures may be expressed in the usual form of an integral—the pressure being supposed constant for one instant. Again; in the expansion of a solid or liquid without change of state, let P denote the mutual attraction or cohesion between any two contiguous particles of the solid or fluid mass; dr the increment of their mutual distance in an indefinitely small time, dt. Then the "work done" in expanding such a mass from one magnitude to another, will be expressed by such an integral as $\int P dr$ between given limits. P will generally be a function of (r), the distance rapidly diminishing as the distance increases, and probably of the form $\frac{\mu}{r^n}$.

In different substances the whole amount of heat, or, in other words, the definite integral between given limits of Pdr being given, the sum will be made up in different ways: in some, the pressure P will be very great, and (dr) very small; that is, there will be great pressure but small expansion, whilst in others the converse will occur, P being small and the expansion (dr) very great.

Lastly, there is the case of a change of form, which, as before mentioned, may be divided into two periods—one in which certain molecular attractions have to be overcome, and in which therefore the action going on is of the same kind as in the expansion of solids or fluids, without any change of form; and the second, in which attraction ceases, and gives place to repulsion, and this obviously may be expressed, and the action measured, in the same way. In the expansion of a bar of metal or other solid, there is a constant resistance from the very constitution of the substance itself, and therefore a great absorption of the useful effect, inasmuch as it is not our object to expand the metal itself, but simply, by means of this expansion, to procure a pressure against some external substance. In the expansion of air and gases, there is not only no such internal resistance to the expanding power, but just the reverse. A quantity of air in a bladder, for instance, is already of itself exerting just that sort of pressure against an external object, namely, the bladder confining it,

which it is our purpose to obtain in some form or other. It is true that this is neutralized by the equal pressure of the surrounding air; but, in so far as there is no *opposition* to expansion, there is what may fairly be termed a *gain* of that sort of force which we want, as compared to solids. From this it would appear that it is more economical to use air or gases as our intermediate agent (B), rather than any solid, or even fluid, if the fluid is not dilated so far as to become a gas.

(*To be continued.*)

ON THE INVENTION, AND FIRST INTRODUCTION OF MR. KŒNIG'S PRINTING MACHINE. BY RICHARD TAYLOR, ESQ., F.S.A., F.L.S., ETC.

[From the *Philosophical Magazine* for October, 1847.]

"As a step in the progress of civilization, the Steam Press can only be compared to the original discovery of Printing itself."—*Times Newspaper, July 29, 1847, on the death of Mr. J. Walter.*

More than a century after its introduction, the first invention of the art of printing became a subject of long-continued controversy, remarkable for the insufficiency and fallacy of the most confident assertions resting upon pretended traditions and unsupported conjectures. And, as Hadrian Junius, in 1575, first disputed the claims of Gutemberg after so long a period had elapsed, so did Atkyns, as late as 1664, first deny the title of Caxton to the honour of having introduced the art into our own country. Hence one of the writers in this controversy remarks, that "the art of printing, which has given light to most other things, hides its own head in darkness."

It will be our own fault if we allow any unfounded assertions and pretensions to obtain currency with regard to an improvement in the art, of which the *Times* newspaper has said, that "from the days of Faust and Gutemberg to the present hour there has been only one great revolution in the art of printing, and it occurred in the year 1814. Of that revolution Mr. Walter *was the prominent and leading agent.*"

Now, though I would on no account detract from the general merits of the late Mr. Walter, as set forth in the Obituary and extended Memoir which appeared in the *Times* of the 29th of July and 16th of September, yet I cannot allow the representations which are made in these articles, as to any share which he is alleged to have had in this important invention, to pass without the most unqualified contradiction.

In the Obituary we read as follows:

"But one achievement alone is sufficient to place Mr. Walter high in that list which the world, as it grows older and wiser, will more and more appreciate.

'Inventas aut qui vitam excoluere per artes,
Quique sui memores alios fecere merendo.'

He first brought the steam-engine to the assistance of the public press. Familiar as the discovery is now, there was a time when it seemed fraught with difficulties as great as those which Fulton has overcome on one element and Stephenson on another. To take off 5,000 impressions in an hour was once as ridiculous a conception as to paddle a ship fifteen miles against wind and tide, or to drag in that time a train of carriages weighing 100 tons fifty miles. Mr. Walter, who, without being a visionary, may be said to have thought nothing impossible that was useful and good, was early resolved that there should be no impossibility in printing by steam. It took a long time in those days to strike off the 3,000 or 4,000 copies of the *Times*. Mr. Walter could not brook the tædium of the manual process. As early as the year 1804 an ingenious compositor, named Thomas Martyn, had invented a self-acting machine for working the press, and had produced a model which satisfied Mr. Walter of the feasibility of the scheme. Being assisted by Mr. Walter with the necessary funds, he made considerable progress towards the completion of his work."

"On the very eve of success he was doomed to bitter disappointment. He had exhausted his own funds in the attempt, and his father, who had hitherto assisted him, became disheartened, and refused him any further aid. The project was therefore for the time adandoned" [Why abandoned, we may ask, if so feasible, and on the very eve of success?]

"Mr. Walter, however, was not the man to be deterred from what he had once resolved to do. He gave his mind incessantly to the subject, and courted aid from all quarters, with his usual munificence. In the year 1814 he was induced by a clerical friend, in whose judgment he confided, to make a fresh experiment; and accordingly the machinery of the amiable and ingenious Kœnig, assisted by his young friend Bauer, was introduced—not, indeed, at first, into the *Times*, but into the adjoining premises; such caution being thought necessary from the threatened violence of the pressmen. Here the work advanced, under the frequent inspection and advice of the friend alluded to. At one period these two able mechanics suspended their anxious toil, and left the premises in disgust. After the lapse, however, of about three days, the same gentle-

man discovered their retreat,* induced them to return, showed them to their surprise their difficulty conquered, and the work still in progress."

Who would not infer from the above, that Mr. Walter, having determined "to make a fresh experiment," in pursuance of those which he had long before abandoned (notwithstanding his early resolution that there should be no impossibility in it), and "courting aid from all quarters with his usual munificence," had been actually the person that enabled Mr. Kœnig to pursue his labours on Mr. Walter's premises, "under the inspection and advice of Mr. Walter's clerical friend," and thus to produce his invention? Whereas, in truth, Mr. Walter knew nothing of Mr. Kœnig till after his invention had been completed. He was merely the first newspaper proprietor who purchased from the patentees the printing machines long before invented by Kœnig. Of these patentees I was one, and as I am now the sole survivor, it devolves upon me to contradict any erroneous statements and unfounded pretensions. I feel this to be the more necessary, as already the misstatements of the *Times* are circulated, with additions and exaggerations, in other journals. Thus, in an article in the *Mechanics' Magazine* for September 18, copied into the newspapers, I find the following passage:

"No sooner were presses made of iron, than the idea occurred of working them by steam; and the first to welcome the new and happy thought was the proprietor of a journal which stood in instant need of some such powerful auxiliary to enable him to keep pace with a circulation unexampled in the history of the press, and who, without it, would most assuredly never have been able to attain to that prodigious influence which for many years past has at once astonished and awed the world. Kœnig, the ingenious inventor of the steam-press,† found in the proprietor of the *Times* his natural and best possible patron. *With the liberal aid of the late Mr. Walter, he produced a machine* of somewhat gigantic size, but nevertheless possessing a completeness of design and purpose which cast all other surface printing-presses into the shade."

And again,—

"The steam-press has given occupation to many thousands, who, but fo[r] duction, would have been standi[ng] who ought, one and all, to bless t[he] of Mr. Walter for *enabling the* [...] *work out his ideas*, and perfect hi[s] glorious undertaking."

Now the whole of this is a f[...] Walter was no "natural and be[st] patron" of Mr. Kœnig's,—ga[ve no] "liberal aid in producing his ma[chine,"] did anything whatever to "ena[ble ...] work out his ideas." These h[e had] worked out long before; patent[s were] taken out, a machine had been [...] was in operation on the prem[ises of the] patentees, before ever Mr. Wal[ter, or any] other newspaper proprietor, wa[s ...] and invited to adopt it. Mr. P[erry, of the] *Morning Chronicle*, declined, al[...] he did not consider a newspap[er worth so] many years' purchase as would [...] cost of machines. Mr. Walter [...] cautious man of the world," bu[t ...] ing, "it being," as his biogra[pher says,] "his habit in the game of life ne[ver to throw] away a chance," when he had fu[lly satisfied] himself by seeing that the inv[ention was] accomplished, and in effective [...] consented to give an order for tw[o ...] for the cost of which he paid u[...] sum, and a rental according to t[he number] of copies printed; and this rent v[...] until it was commuted for a [...] upon.

I do not mean to charge the w[riter in the] *Mechanics' Magazine* with any [...] misrepresentation. He has evi[dently been] misled by the articles in the *Th[e Times]* though they do not *directly* ass[ert ...] he has inferred from them, yet th[...] much. Thus a story gains in [...] till the most vague and unfoun[ded asser]tions, if uncontradicted, are assu[med as in]disputable facts; and it would b[e ...] that if Kœnig was the Guttemb[erg of the] new discovery, Walter was at leas[t the Faust] or Schœffer of the affair, or rath[...] one.

I am convinced that Mr. Walt[er, were he] living, would disclaim the prete[nsions which] have been made in his name; an[d ...] has done so in the announcem[ent which] appeared in the *Times*, Nov. 20, [...] day on which that journal was fi[rst printed] by the machines, and which co[ntains the] following passage:

"That the completion of an in[vention of] this kind, not the effect of chanc[e, but the] result of mechanical combination[s methodi]cally arranged in the mind of [the artist,] should be attended with many o[bstructions] and much delay, may be readil[y admitted.] Our share in the event has, in[...]

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* To me this story appears not a little extraordinary:—the "discovery of the retreat" of Messrs. K. and B.! who were every day to be found superintending our factory in Whitecross-street.—R. T.

† Mr. Kœnig's invention is very inappropriately designated by the terms "steam-press," and "the working of iron presses by *steam*." Its construction is wholly independent of the motive power employed.

s application of the discovery, under
ement with the patentees, to our own
lar business."

e time for effecting the great revolu-
the art of printing," says Mr. Wal-
ographer, "did not arrive till the
314." Now it was in 1809 that,
r with the late Mr. George Woodfall,
d Mr. Kœnig and Mr. Bensley in
out patents,* the machine being even
far advanced as to satisfy us as to
spect of success, and to enable us to
ie specifications drawn up. Kœnig
ie on with Bensley, to whom I had
iended him some few years before, up
year 1809, when the taking of pre-
nd the purchase of lathes, tools, &c.,
e employing of workmen, with the
of Mr. Kœnig and his able and ex-
assistant Mr. Bauer, led Bensley to
s to a partnership in the undertaking.
eral years it occupied much of our
d attention, and cost us much money
which we had no return) and much
. Each experiment suggested some
ment, and one improvement led to
so that additional patents had to be
out. But with Mr. Walter we had
f us any communication, until, as I
fore stated, the machine had been
ed, and was at work on our own
s.

e thought it right, under the circum-
to put on record my own recollec-
to the progress and introduction of
vention: and though they relate to
ions which took place from thirty to
ears ago, I believe they are in the
rrect, and can be confirmed by docu-
r evidence.

IC TELEGRAPHS.—MR. HATCHER'S IMPROVEMENTS.

dated March 23, 1847. Specification en rolled September 23, 1847.]

: several improvements are de-
in this specification:

irst consisting in arranging and dis-
of magnets in such a way that when
ric current is transmitted through
step by step motion is communi-
o the machinery with which they are
ed; which motion may be employed
r turning an index-hand, so as to
ut letters, words, or symbols on a
te, or in turning the dial-plate

itself. This the patentee effects by means of apparatus, such as represented in fig. 1. A is the index-hand, and *a* its arbor;

Fig. 1.

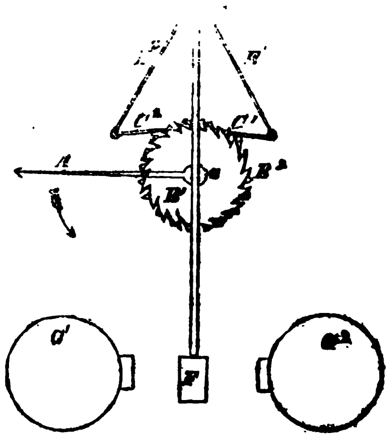
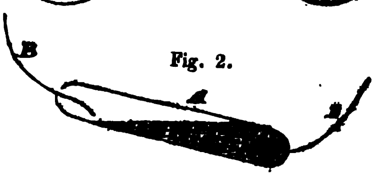


Fig. 2.



B^1 B^2 two ratchet-wheels fixed upon the arbor *a*, with their ratchet-teeth placed in the reverse direction the one to the other. C^1 C^2 are two palls, or pushers, which are attached to a spindle, D, by two light arms of metal, E^1 E^2: from the end of this spindle D, there is suspended a permanent magnet F, which occupies an equidistant position from and between the two electro-magnets, G^1 G^2. As the permanent magnet is attracted by the one or other of the electro-magnets, the index-hand is turned either to the right or left accordingly by the action of the pushers, C^1 C^2. Thus, supposing the electric current were to dispose the attraction of the permanent magnet F towards G^1, then the index-hand would be turned by the action of the pusher C^1 upon the ratchet-wheel B^1, in the direction of the arrow; but if the direction of attraction has been determined towards G^2, then the motion of the index-hand will be in the opposite course. The operator, or the person directing the current, has it thus in his power to bring the index-hand to any required position on the index-plate or dial, simply by causing it to move either in a forward or a backward direction, whichever may be the most convenient or the shortest

of the four patents bears date March 29,
ee Phil. Mag., vol. xxxv., first series, page
was taken out in the name of Frederick
nd was assigned by articles of partnership
n of Bensley, Kœnig, Woodfall, and Tay-

route to the letter or symbol to be indicated upon the dial.

The patentee proposes also to connect with his apparatus two bells of dissimilar sounds, by which the attendant reading off the symbols indicated, may know with certainty in which direction the index-hand is progressing.

The *second* improvement relates to the means of forming the metallic connection between wires through which electric currents are transmitted, particularly where such connections have frequently to be madc and broken. The sketch, fig. 2, illustrates how this is effected:—A is a tube of glass containing a portion of mercury; after the mercury has been introduced, the atmospheric air is expelled, and the tube hermetically sealed, by which the mercury is prevented from becoming oxidated. B B are the wires; the openings through which these wires are passed into the tube are hermetically sealed. When the metallic connection is to be formed, the tube is brought into the horizontal position, but when broken it is put in that in which it is represented in the figure.

The *third* improvement consists in regulating the time of a number of clocks, or time-keepers. When it is wished that they should all indicate exactly the same time, Mr. Hatcher effects this by having each of the clocks fitted with an electro-magnet, which is placed behind the dial in the same position through the whole series or line of clocks, as at 12, over which the minute-hand will stand at the end of each hour. The first of the line of clocks has an apparatus attached to it, by which, at the instant the minute-hand indicates the completion of the hour, the electro-magnets of the whole line are brought into action for a brief instant of time. If the minute-hands of the other clocks are put upon their arbors with a degree of tightness (which may be effected by a spring) sufficient to keep them in their places, and to cause them to move with their arbors, but yet such as to leave them at liberty to be acted upon by the electro-magnets of their respective dials, then the instant the action of the electro-magnets is brought into play, the minute-hands of the whole of the clocks will be brought to 12.

DOUBLE CYLINDER SAFETY-VALVE.

Sir,—I send you herewith drawings of a Safety-valve, which I think I may call Double-cylinder Safety-valve, for insertion in the *Mechanics' Magazine.*

It consists of a cylinder, the upper part of which is smaller than the lower, with two pistons fitting therein, the pi tons to be cast in one piece and to have free passage for the steam to pass to t upper part of the cylinder.

Fig. 1.

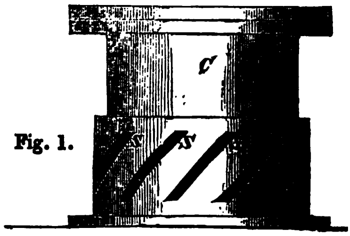


Fig. 2.

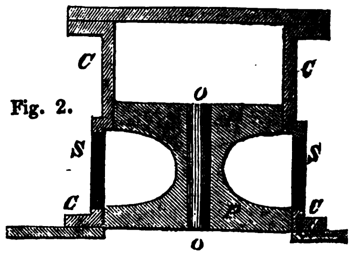


Fig. 3.

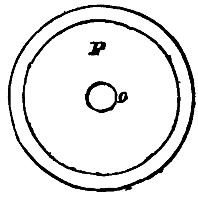


Fig. 4.

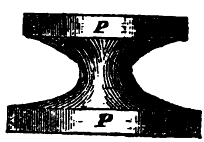


Figure 1, is an outside view of th valve-cylinder; fig. 2, a cross section of the cylinder and valve—C is the cylinder P, the pistons; O, the opening to allow the steam to pass to the upper part abov the small piston; S, the eduction pas sages for the steam to blow off. Now suppose the required pressure to be 5 lbs per inch, and that the two pistons weig together 60 lbs., the lower piston must b 12 inches greater in its superficial are

ıpper. Again; suppose the 'essure to be 60 lbs. per inch, tons weigh, as before, 60 lbs., ower piston must be 1 inch its superficial area than the us doing away with springs and Fig. 3, is a plan of the pising the hole for the passage n; and fig. 4 is a view of the ıs.

in practice the cylinders should vith brass, and the eduction ıade something in the manner g. 1, that the lower piston may ly.

ing for thus far trespassing on ıle space.

main, yours &c.

T. Moy.

ıldings, Sept. 29, 1847.

ʼs DOMESTIC TELEGRAPH.

under the Act for the Protection of ility.]

ple who do not like to have in constant waiting upon them, : to spare all superfluous trouir attendants—who would be ı the greatest possible promptyet with the least possible to an excellent contrivance:

l is a sectional elevation, and nt view of the apparatus. A, is :asing (of which a plan is given in fig. 3,) which is to be he wall of the dining-room or tment up stairs; B, is a dial, o separately in fig. 4,) contain- of the servants and of the icles in daily requirement in a ouse or other establishment, ɔhabet and any numerals re- The plain part, C, of the dial correspond in appearance with so that when the apparatus is ıal use, nothing unsightly may The handle is fixed to the dial, ; on a spindle, through the On moving the handle round, re in the casing exposes a porıe list to view, and on the ord being set to the horizon- ı corresponding word appears n opening, D, in the casing ;. 5 and 6,) which is fixed in n or servants' hall, and has a ıich works in the same manner ɜr. The two parts of the ap- ɜconnected by wires and chains, working over pulleys, and balanced so that the servant, in acknowledging the signal, pulls back the handle to its original position, and again conceals the list from view.

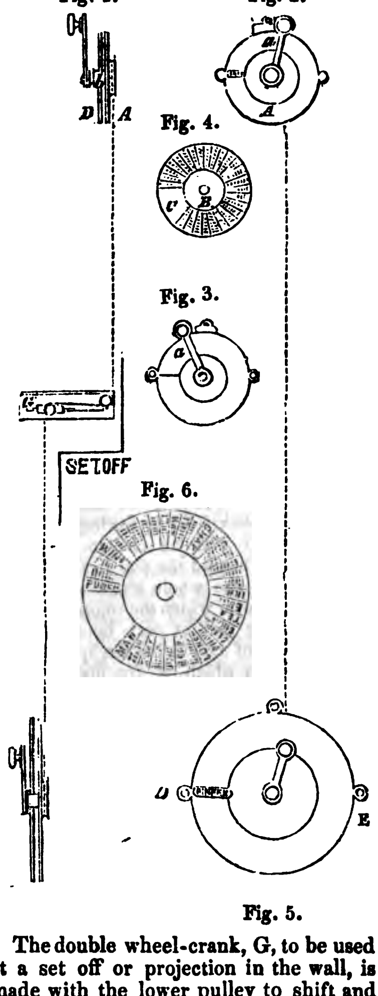


Fig. 1. Fig. 2. Fig. 4. Fig. 3. Fig. 6. Fig. 5.

The double wheel-crank, G, to be used at a set off or projection in the wall, is made with the lower pulley to shift and fix with set screws at any required distance from the other, which much facilitates the fixing of the apparatus.

The first movement of the handle may be made to pull a bell, by means of a trigger attached to any part of the apparatus, in order to call the servants' attention to the signal.

CHAPTERS ON ANALYTICAL GEOMETRY. BY JAMES COCKLE, ESQ., M.A., BARRISTER-AT-LAW.

(Continued from vol. xlvi., p. 324.)

CHAP. VI. *On the Ellipsoid.*

SECTION 1.—*Criterion.* The following Example will show how to distinguish the equation to the ellipsoid :

Ex. (1.) Determine the nature of the surface represented by the equation

$$2x^2+5y^2+3z^2+2yz-4zx-2xy+2x+8y-6z-13=0$$

[*Leroy, Analyse, &c.*, (Par. 1835), p. 159, No. 241.]

Proceed as follows (*a*) ;

x^2	yx	zx	x	y^2	zy	y	z^2	z	1
2	−2	−4	2	5	2	8	3	−6	−13
·	·	·	·	×2	·	·	·	·	·
$+2^2$	−2.2	−4.2	2.2	10	4	16	6	−12	−26
				1	4	−2	4	−4	1
				9		18	2	−8	−27
				·		·	·	·	·
				$+3^2$		6.3	2	−8	−27
									9
							2	−8	−36
							·	×2	·
							$+2^2$	−8.2	−72
									16
									−88

The reader who has referred to previous *Chapters*, will find that the above operations show that the given equation may be reduced to the form

$$u^2+v^2+w^2-n^2=0$$

where n is a numerical quantity. Hence the surface, represented by the equation first above given, is an *ellipsoid.*

SECTION 2. *General Remarks.* For the sake of perspicuity, the foregoing process is given at considerably greater length than is absolutely necessary. The method on which it is founded—the *method of vanishing groups* (*b*)—has yet to be further discussed in its relation to the theory of surfaces. And I trust, at no very distant time, to consider the same process in reference to the subject of the Transformation of Coordinates.

SECTION 3. *Propositions.* With this manner of distinguishing the equation to the ellipsoid is connected the following proposition :

When a surface of the second degree can be touched [in a point] *by two planes parallel to, and at a finite distance from* (b′), *a coordinate plane, then—provided a plane, drawn parallel to those planes, and lying between them, meets the surface—the surface is an ellipsoid.*

Thus, in the Example just given, the planes $w=n$ and $w=-n$ meet the surface in points determined by the equations $u=0$ and $v=0$; and, since w is free from x and y, those planes are parallel to that of xy. Moreover, the planes whose equations are

$$w=\sqrt{n^2-m^2} \text{ and } w=-\sqrt{n^2-m^2}$$

lie between the former ones and are parallel to the plane of xy; they also meet the surface in the curves (ellipses)

$$u^2+v^2-m^2=0$$

m of course representing any number less than n. If m be taken greater than n, our results are no longer real.

(*a.*) See *Mechanics' Magazine*, vol. xlvi., p. 293, *Ex.* (δ); and also pp. 322, 323. I have there employed an abbreviated process, as I have also done in the text.

(*b.*) *Vide supra*, p. 307.

onverse of the above proposition is also true. Thus,

ipsoid can always be touched [in a point] *by two planes parallel to, and te distance from,* (b) *a coordinate plane: and all planes drawn parallel etween those two planes, meet the surface (in an ellipse or a circle.)*

e coordinate planes are, in this respect, similarly related to the surface d);—

t the "characteristic property" is not, in the case of the ellipsoid, "con- two of the coordinate planes," and there is no "modification in the case of oid" corresponding to that which occurs in the case of the hyperboloid of ts. The reader will be pleased to consider as corrected my remarks upon t at page 247 of the last volume of the present work (c.)

nection with the subject of the ellipsoid, I have the pleasure of laying before rs of this paper two theorems, due (d) to Professor Young, of Belfast, and cated to me some six months since, with a letter from that learned mathe- They are as follows:

'*very ellipsoid is equal in volume to an ellipsoid of revolution whose fixed qual to the perpendicular distance between the umbilical tangent planes, of the other axes equal to the diameter of the principal circular section of r.*"

When the diameter through the umbilical points makes an angle of 45° with nts at those points, the equivalent ellipsoid of revolution is a sphere."

sor Young adds the following observation:

The truth of the above immediately follows from the principle of Cavellerius: o solids of equal altitude are equal when the sections made by any plane, the two within which they are placed, are always equal. The proposition ellipses as well as to ellipsoids."

hese propositions of the Professor I shall conclude this *Chapter*.

ctory, September 30, 1847.

(To be continued.)

THE STEAM VOYAGE OF H. M. S. "INFLEXIBLE."

[From the *Sydney Morning Herald*, Feb. 18.]

ract the following interesting paper *New Zealander*, a weekly paper at Auckland, to which it has been l from the *Sydney Morning He-*

vo irresistible claims to a place in is; viz., first, it is an authentic the longest steam voyage which er yet accomplished; and second, a triumph of steam power, worked r, achieved under the immediate f a much-esteemed correspondent (Captain Hoseason,) whose able this Journal, on the Expansive must be still fresh in the recollec- ir readers. The voyage of the nay be considered as the best ractical commentary of the ad- f the expansive system. ED.

discussion on the steam communication question, following upon the movement recently made in England to obtain the establishment between Sydney and Singapore, the application of steam navigation to the direct sea course by the Cape of Good Hope has not been considered. In the present position of the question, it may be advisable to limit our expectations and exertions to the attainment of the lesser scheme, as affording the readiest means of effecting the object of rapid mail-packet communication, leaving the greater and more important establishment to future commercial enterprise, and progressive advancement of the science. Such being the present feature of the subject, any prolonged delay in carrying out the Indian extension will be regarded with dissatisfaction. New South Wales has come pre-eminently forward by offering her aid towards the maintenance of the projected undertaking, *viâ* Torre Straits

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chanics' Magazine, vol. xlvi., p. 322, col. 2, line 10 to 17, and note †. The origin of coordi- scarcely necessary to state, treated as being situate at a finite distance from the centre (or e surface.

chanics' Magazine, vol. xlvi., p. 247, col. 1, lines 10 to 22. The sentence commencing at line g at line 22 of that column, is inaccurate. The one preceding it is correct. The two sen- fact, inconsistent.

ot aware of their having appeared before.

to Singapore, and has temporarily laid aside the claims of the Australian colonies to a separate mail-packet establishment, in the expectation of more immediately reaping the benefit of quick postal communication by a junction with the existing line in China. The colonists naturally presume that they are now on the eve of obtaining this desirable communication; and may still hope that the establishment of the *commercial route*, by which the conveyance of goods and passengers from England can be effected as rapidly as the mails overland, will also in due time be carried into effect.

Every practical advance, as well as actual improvement in steam navigation, is a step towards the fulfilment of the latter project; the recent arrival of H. M. steam sloop *Inflexible*, in the harbour of Port Jackson, from Devonport and the Cape of Good Hope, has been regarded with peculiar interest—the first voyage approaching to the character of a steam passage to Australia having been effected by this steamer, and with highly satisfactory results. This vessel, the inspection of which during her stay in our harbour, afforded no small gratification to numbers of our fellow-citizens, as exhibiting to them, for the first time, various improvements in the formation and application of the marine steam-engine attained of late years, will, by her arrival, form an epoch in colonial history, and by the performance of her voyage mark an era in the progress of navigation by steam. Ever since the successful voyage of the *Great Western* on the Atlantic, the practicability of reducing by one-half the present term of the voyage to Sydney, by the employment of similar vessels, has been advocated and urged: but until the present era, all the submitted estimates were comparative theory. The *Inflexible* has surpassed theory in many respects, and therefore the following brief analysis and leading results of her voyage may prove interesting, and at the least highly instructive:

Allow me to observe, in the first place, that the *Inflexible* measures 1,122 tons, and was built at Milford Haven in 1846. Her engines are of older construction, and were originally intended for another ship, as the appearance of the cylinder-shafts above deck tends to show. Her two direct acting marine engines are of the nominal horse power of 375 horses, and are fitted with the expansive gear. Her four boilers are oblong shaped, with three flues to each. The engine-room is about one-half less than in the old engines; this great saving is owing chiefly to the cranks being placed, and *acting directly*, above the cylinders. The operation of the expansive principle is that which effects the great saving in the expenditure of fuel. As the action of the wind on the sails assists in propelling the vessel, there is, therefore, so much the less steam power required in order to maintain the necessary speed. By the plan introduced of cutting off the steam in its passage to the cylinder, and causing the piston to work expansively, this saving is effected, both simply and efficiently, and is regulated with accuracy, according to the state of the weather and the speed attained. On the passage to Australia, sufficient steam was generated by the employment of *nine*, and frequently only *six* flues out of the *twelve*, to acquire a speed of from seven to eight knots. The usual practice is to work the engine expansively, excepting when the speed is reduced to six knots, on which occasion the full steam is then applied. When the wind is strong in favour, with a moderate sea, the steam power employed on the expansive system is little more than what may be just necessary to turn the paddles. Great facilities are afforded during the application of the expansive principle for cleaning out the boilers, which can be done in turn, without diminishing the ordinary speed; and, by frequently performing it, the accumulation of sediment is prevented, thereby promoting the preservation and safety of the boilers. Coal-boxes are ranged between the machinery and sides of the vessel, and are thus made subservient to preserve the vital parts against injuries more peculiar to war-steamers. The capacity of the *Inflexible* for fuel is 500 tons. Her large paddle-boxes, although fitted with a life-boat on each, and comprehending places for culinary and other useful purposes, are an obstruction during head winds and heavy seas. By the frequent alternate emersion and immersion of the paddle-wheels, much power is lost in ocean steaming, and the application of the screw principle on this voyage is still a desideratum promising greater results. The plan of "disconnecting" has been in use by war-steamers for some time, but is effected in the *Inflexible* on a different principle from that formerly in use, and which occupies one-tenth of the time; it is that of the friction-strap, and merely requires the turning of two screws, and striking aside the keys which connect the parts, in order to set the paddles free of the engine.

On her departure from Devonport, on the 9th of August last, the *Inflexible* had 392 tons of coal in her boxes,—considerably less than her quantum; 80 tons of patent fuel intended for her use having been left behind—probably in consequence of the large amount of dead weight already on board—being not less than 150 tons, exclusive of fuel. The total weight of cargo, fuel, engines, boilers, water, stores, ammunition,

mated at 1,200 tons. She then
6 inches forward, and 15 feet
t; immersion of paddle-wheels
es. From the 9th to the 28th
ie course of the *Inflexible* was
could be taken for the Cape of
; at the latter date she had made
alf the distance between England
e, being near the equator, in lat.
n. 13·27 W. This point was
period of eighteen days sixteen
average speed per diem of 179
es, or 7½ knots per hour; being
y the log, and direct course 3,200
attained this point in the above
expenditure of 218 tons 6 cwt.
eraging 11 tons 13 cwt. per diem.
h to the 13th of August, the sea
ong from the west, the wind
om the same direction. The
rades were met on the 13th, and
il the 23rd. During their con-
e average speed was 180 per
onsumption of fuel 10 tons 3 cwt.
ing of the 23rd, the wind veered
uth-east, and again to south-
with a rough sea setting in from
est, which continued for some days,
28th of August there remained
thousand miles to perform be-
ng Table Bay, Cape of Good
the quantity of fuel on board 173
. It had not been arranged for
ble to coal at any station between
nd the Cape, otherwise a direct
it have been kept. This defective
it added twelve to fifteen days to
of her passage, as her commander
necessitated to diverge from the
h the view of reaching the south-
nds to assist in carrying the *In-*
the Cape. The equator was
the night of the 29th of August,
1st of September the *Inflexible*
nected, and was making all sail
e coast of Brazil, with a south-
eeze, which lasted one week, by
she reached 21·33, her extreme
tude, in 18·15 south latitude.
m up, she met south-westerly
d experienced a rough cross sea
, which on the 10th is changed to
th-west swell—the weather calm;
and consumption 13 tons.
d again came from the east, but
ept up till the 16th, when, being
, 90 miles is entered as the
The *Inflexible* kept under sail,
varying from south-east to south-
the 26th; when steam was got up,
ade St. Helena Bay, Cape Colony,
h, and was at anchor in Saldanha
Bay, on the 28th September—hav-
plished the total run from Devon-
port in forty-nine days, of which thirty-two days were under steam, and seventeen under sail only. From the point of divergence on the 28th of August to the 28th September, the distance run per log was 4,363¾ nautical miles; nearly 1,500 over the direct course. Her average speed during this period was 140 nautical miles per diem:

The time under steam, 13½ days.
,, ,, sail, 17½ ,,

Average speed under steam, 158 nautical miles.

Average speed under sail only, 127½ nautical miles.

Average consumption of fuel per diem, when under steam, 12 tons 6 cwt.

The public service required the *Inflexible* to remain six weeks at the Cape Colony; and having discharged a portion of her dead weight, and taken on board 460 tons coal, she left Simon's Bay at 2 P. M. of the 8th November, and arrived at Sydney at half-past eight P. M. on the 13th December.

The passage from the Cape was performed therefore in 65 days 6½ hours, of which period 160 hours, equal to 6 days 16 hours, was under sail only, and the remaining 28 days 14½ hours under steam. During eight days of the passage the practice was to disconnect each morning, and get up steam towards nightfall, and on two days and nights the steamer proceeded under canvas. The draught of water in Simon's Bay at starting was 14 feet 6 inches forward, and 16 feet aft—the immersion of paddle-wheels 5 feet 6 inches. On arrival in Port Jackson she drew 13 feet, and had about five tons of coal remaining in the boxes. Her average consumption therefore on the passage was 15 tons 17 cwt. daily, while under steam.

The passage of the *Inflexible* is memorable, inasmuch as it is the first steam passage from the Cape to Sydney (from England to the Cape, and thence to India has been frequently done;) and it is the longest run at one stretch of any steamer under steam in the annals of steam navigation. I may, therefore, be allowed to deduce more particulars from the copy of the log in my possession:

After leaving the Cape of Good Hope, the course was south-west for a couple of days; the wind at starting was at south-east; next day it veered to south-south-west, and a heavy south swell with it: nine flues employed, and plain sail; consumption 18 tons 8 cwt.; speed, 7½ knots, or eight miles for each ton of coals. The morning of the 11th was variable, but it blew strong from south-south-west at noon, with a heavy south swell of the sea; speed, 8½-th knots. At night the wind came more from the west, and next day it blew a strong gale (the strongest experienced on the passage) from west-north-west; the average speed per log during the day, 8 5-12; but 240 miles were made by observation—the longest run in twenty-four hours, equal to ten knots per hour; consumption 16½ tons, with double-reef top-sails; ocean swell heavy from the

west. On the 13th, the wind was W.S.W., and variable, and a long west swell experienced; speed per log, about 9 knots, with all plain sail. On the 14th, a north-easterly breeze sprung up, which increased considerably on the 15th, with a rough sea. consumption 14 tons, speed 8¾ per log, with reef topsails, and 235 N. M. made by observation. On the 16th, it came on again a westerly gale, with a heavy swell, 12 miles per ton consumed of coal, speed 8⅓th. The 17th moderated, the wind veering from south-east to north-east till the evening of the 18th, when a gentle breeze came on from north-north-west, sea smooth. The like on the 19th and 20th, but speed diminishing, steam was got up in evening. Next day the weather was nearly calm, speed 7 1-9 knots, and 13½ miles per ton of coal; lat. 3.39 S., long. 68 W. On the 22nd there was a moderate breeze from north-north-east, speed 7½. It came again from north-west on the 23rd, and steam let off. Next day it was stronger from west-south-west, with a rough sea; proceeded under sail only this and the following day, speed about eight nots. On the 26th of November, steam was got up with a south-west wind, and towards evening there was a long west swell, and "ship rolling deeply;" speed 6 3-5, and 12¾ miles to ton of coal consumed. The next day 17 miles were averaged to the ton; speed 7¾, wind north-north-west. On the 28th, under sail, a long west swell, which continues for some days, steam got up each night, and let off in the morning, until 2nd December. During this period the wind varied from north-west to south-west, speed about eight knots, with plain sail. There was a heavy swell on the 2nd, and steam was continued from that day continuously to the close of the voyage. On the 3rd, with a gentle south-west breeze, sixteen miles was averaged for each ton of coal, speed per log, nearly nine knots. On the evening of the 5th, the wind varied, and came light from the north on the 6th, but calm at noon. Latitude 40·23·30 south, longitude 131·34 east. Nearly sixteen tons of fuel consumed this day.

The next three days the wind was easterly, the consumption increasing, and on the 9th December there was a strong head swell, "heavy from the east," consumption 21 tons 14 cwt., speed 6 5-6 per log, 7 3-5 miles only per ton of coal; being the largest quantity in one day, owing to the head wind and sea requiring the necessary employment of full steam. On the 10th the weather moderated, the wind still from north-east, consumption reduced to 17 tons 14 cwt., and speed increased to 7¾ knots. Entering Bass's Straits. On the 11th and 12th, having strong north-north-east winds, steering up this coast the speed is rather under 7 knots, consumption on that day 12 tons, 13¾ miles to a ton, which on 12th is reduced to 9 miles per ton; the consumption having increased to 18 tons. Next evening the *Inflexible* anchored in Port Jackson.

The speed per log given in the above sketch of the voyage, is the average speed during twenty-four hours. The aggregate of the daily runs on the whole passage, from the Cape to Sydney, is 6,400 knots per log, whereas, the actual distance is 6,600, and allowing for extra latitude being made, the actual ground gone over could not be less than 6,700 nautical miles.

The average speed per log per diem, was 181·⅓th—7½ per hour.

	Days.	N.M.	Per diem.	Per hour.
Of which, under steam	25	4,635	185 2-5	7¾
Of which, under sail only	2	344	172	7⅙
Of which, under part steam and part sail.	8	1,421	177 2-8	7 2-8
	35			
Total miles per log		6,400		

Taking the actual distance gon[e] the *Inflexible* at 6,700 nautical [m] average speed on the passage was per diem, or eight knots per h[our] nearly.

During the passage, the wind [was]

A westerly direction during 20 days.
An easterly „ „ 10 „
Wind variable „ „ 5 „

The following is a brief summ[ary] whole voyage from England:

The distance from Plymouth Sound to [Simon's] Bay, *viâ* Madeira and Cape de Verde ...
The distance from Simon's Bay to Port J[ack]son...
Total distance from England to Sydney, [viâ] Cape of Good Hope...............................

			Nautical miles traver[sed]	
	Days.	h.	per log.	p
Number of complete days under steam..	57	4	10,115	
Number of complete days under sail only	19	12	2,572⅝	
Number of complete days under part sail	8	0	1,421	1
Plymouth Sound to Port Jackson.........	84	16	14,108⅝	

Total coal consumed on the passage ...
Average consumption per diem ....
Average number of miles for each ton of coal ....
Average consumption of fuel per horse power, per hour.......................................

There are circumstances atten[ding the] voyage of the *Inflexible*, which [detract in] some degree from the success, alt[hough not] from the value of its performan[ce. As a] war-steamer, she is not so well a[dapted for] the purposes of speedy conveyan[ce as] commercial vessels of like capa[city, nor] does she, in respect to size and po[wer, come] up to the Atlantic or Indian pac[kets.] The nature of the service she ha[s to per]form, requiring large stores of am[munition] to be conveyed, must have detra[cted] considerably from her sailing quali[ties, par]ticularly at the commencement of th[e voyage;] without question the most remarka[ble point] gained by her voyage is the small[quantity] of fuel consumed. It must also [be recol]lected, that the nature of the p[assage, in] respect of winds and weather, [and the] application of the expansive prin[ciple, is of] the first importance to this savin[g.] These satisfactory results therefo[re may be] taken as indicating the favourable [nature of] the passage to Australia, and the [possi]bility of reducing it to a com[paratively] limited period, at an expenditur[e of fuel] much less than has ever been [supposed.] Clearly to perceive the difference, [it must] be borne in mind, that, during t[he whole] passage the full steam was not ap[plied, ex]cepting on leaving port, and on one [occasion,] a heavy sea and head wind, which [happened] very seldom. At all other times i[t] acted rather as an auxiliary to the

ened or increased according to the the wind and the state of the sea. ect was to obtain a tolerable degree at a small consumption of fuel, and le voyage was effected at an average 8 knots, with an expenditure little an half of what might have been re- for the attainment of 9 knots. It refore be perfectly practicable to re- period of the sea passage to Sydney ys from Plymouth, by the employ- the expansive principle, at a total ption not exceeding 1,000 tons of perior vessels would probably aver- nots, by which the sea passage would ys only, reckoning the distance at nautical miles. On the other hand, require 1,800 tons of fuel, and ad- coals at two depôts, in order to speed of 9 knots, nearly doubling pense in order to gain five days. one part of the voyage of which the le does not afford sufficient data, necessarily made a detour of 1,500 It is a matter of some surprise that miralty should have allowed the *In-* to start on the voyage short of her n of fuel, and without the means of g a supply before reaching the Cape d Hope. It goes far however to he degree of confidence with which essels are now dispatched under all tances on the most distant voyages. *Inflexible* made up her quantum at , or even Madeira, she might have 0 tons to steam direct from the to the Cape. The line was reached ys, at an expenditure of 230 tons at there remained only 160 tons to a distance of 2,800 miles, which a great portion of the passage might a daily average consumption of 20 We will suppose that she had been l, and that her average expenditure tons to acquire a speed of seven This gives her 16 days to reach the an expenditure of 320 tons, being of 13 days: from which, however, ave to be deducted the time taken in it the depôt. On two-thirds of this the south-east trades may be ex- but at certain times of the year less strong than others. About the e of the year the steam-ship *Ben-* perienced them very strong; she from St. Jago in 22 days. The diffi- f this part of the passage may be con- s adding 100 tons to the consump- the voyage; for which reason I have d the total consumption for the voy- ,000 tons. The *Inflexible* was 153 der that amount in steaming 11,000

The passage made by the *Inflexible*, from the Cape to Sydney, in all its results, is most satisfactory, and, in certain respects, exceeds the most sanguine expectations. The distance made under steam was not less than 5,500 nautical miles, at an expenditure of only 455 tons coals, and a speed of eight knots. The average speed, when under sail only, exceeded seven knots per hour; and there was no occasion in the whole passage, where the steam power could have been increased or applied, to have gained any material advantage.

We will suppose that full steam had been used on the voyage, at an expenditure of 21 tons coal per diem, and estimate the speed at 9½ knots. She would barely have reached King George's Sound, the first harbour, a distance of 5,000 N. M., with the 463 tons she had on board, as it would have occupied 22 days very nearly; two days would have been required at least to take in 200 tons coal, with which she might have reached Sydney in eight or nine days: making the time from the Cape 32 to 33 days instead of 35, at an additional expenditure of 200 tons of fuel, besides the depôt expenses. Towards the close of her voyage the *Inflexible* experienced strong easterly winds and a head sea, which increased her average consumption of fuel to 18 tons for five days; in other circumstances her total consumption might have been less by 30 tons.

From this brief smmmary of the passage from the Cape to Sydney already given, it will be observed, that although westerly winds prevailed during 20 days, and were generally strong—sometimes increasing to a gale—steam was not let off. The whole time of her proceeding under sail was two days and part of eight days. Strong south-westerly winds, and a heavy sea from the same direction, are characteristic of this passage above 40° south latitude, at which parallel of latitude the *Inflexible* ran 3,000 miles. By keeping up steam during the prevalence of the strong favourable winds, the paddle-wheel steamer saves wear and tear, and steers steadier. The possibility of taking full advantage of these winds by the application of the screw principle, and saving fuel, affords good grounds for supposing that the expenditure of fuel, small as it is by the paddle-wheel steamer, will be considerably reduced by the screw application, and without diminishing the speed. The screw principle might also be beneficially applied on the latter part of the passage from England to the Cape, as large paddle-boxes catch head winds, and thereby impede the progress of the steam-vessel.

Not the least of the many satisfactory results attending the voyage of the *Inflexible* is

the excellent order in which she arrived, and the entire absence of any wear and tear. May we not hope that the broad highway of the ocean, which enables the Australian continent to be peopled from Europe, will ere long be lined with a steam marine as efficacious as that for which we are now awaiting the accomplishment by the by-ways of Egypt and the coral reefs of Torres Straits?

PREVENTION OF RAILWAY ACCIDENTS.

Sir,—Your correspondent, "C. B, M.," in the last Number (1260) of your valuable Journal, in submitting some suggestions on the subject of railway signals, says that, "Some suggestions for this purpose (warning the engine-driver) have been before the public, *of the insufficiency of which their non-adoption is proof*."

It can hardly be supposed that your correspondent, "C. B. M.," has ever had anything to do with the introduction of any invention, or can be historically acquainted with the all but insurmountable difficulties which for years have prevented the introduction of many of the most useful inventions of ancient and modern times, otherwise he would not have asserted, in reference to any proposed system of signals, that their *non-adoption was a proof of their inefficiency*.

He has, at all events, never had a wet blanket thrown around him, in the shape of a communication with the Railway Commissions, when submitting to their highnesses some proposition on the important subject of safety in railway travelling.

"C. B. M." considers *the recent invention of a whistle, to be sounded by the guard of the train, as the best of the plans proposed*, but seems to think that the application of this apparatus is very limited; and instances a case, such as the recent one on the London and South Western Railway, where a "train may be severed by the fracture of the link between the carriages, and the guard, with his whistle, may be left in the lurch, out of hearing, before the signal could be uttered." Even in this case, however, the guard could amuse himself by sounding his whistle, which would have the effect of preventing a train from running into him from behind, which is the only quarter from which danger is to be apprehended.

In the case of the severance of the train above alluded to, the guard appears to have been asleep, and the writer has been informed that it is not unusual for engine-drivers to take an occasional short nap when over-hard worked. This is a new element in the formula of safety on railways. The whistle, however, if introduced, could be so applied as to keep both driver and guard effectually to their respective posts. Any preconcerted signal to be sounded by the driver every *two*, *three*, or *five* minutes, as may be considered most desirable, and responded to by the guard. Should this be neglected by the driver, then the guard to sound. This reciprocal transmission of signals would keep both parties on the alert, and no doubt prevent many accidents from occurring. It appears quite clear that at present few accidents are traced to their true source.

The Railway Commissioners seem satisfied if they are (to use a huntsman's phrase) *in at the death*. Would it not be better if something were attempted in the way of prevention? Begging the insertion of these remarks,

I am, Sir, yours, &c.,

A.

ADCOCK'S SPRAY PUMP.

The *Mining Journal* of Saturday last contains a letter from Reginald T. Blewitt, Esq., M.P., the proprietor of the Llanhiddel Colliery, in which that gentleman, referring to the doubts that have been raised as to the results of the trial made of Mr. Adcock's pump at his works, says:—"Be assured, whatever may be asserted to the contrary, that the spray pump has been eminently successful; it is in daily operation at my pit at Llanhiddel, and may be seen by any one who will take the trouble to visit the place."

NECESSITY OF A PERIODICAL SURVEY OF RIVER STEAMERS.

Sir,—Having read much of the evidence given upon the several sittings of the inquest upon the unfortunate victims of the late lamentable explosion of the above-bridge river steamer, the *Cricket*, and also the excellent opinions and evidence given by the Admiralty chief-engineer, Mr. Loyd, thereon, I venture to suggest, that it is high time some means were adopted to prevent, as far as possible, any repetition of such a sacrifice of human life. And this, Mr. Editor, might, I think, be to a great degree, if not wholly, accomplished by placing the above-bridge steamers under the same regulation and control as the sea-going steamers, and causing them to be surveyed (and reported upon, if needful) by the newly-appointed officers for that purpose for the port of London. That these small-fry require this interference has long been apparent, and is now placed beyond all doubt by the fact brought out in the course of the recent inquiry, that the

›s were so constructed and placed ıilable for the engineer to tamper —as if, in fact, they were intended ıhow than use. The sea-going, or steamers are generally the pro- ıbstantial companies—abundantly , and engine-fitted in a very supe- r; while those of the above-bridge , being passenger-craft only, are , in some instances, flimsy and arry the vast numbers of human ı which they are daily and hourly especially during the summer nd the majority of them are man- ties chosen from a cheaper and less ss of men than the sea-going steam less skilful, and more reckless. , therefore, for its future safety, nd, in justice, that this class of ıhould be subject to survey at not distant periods; and if found any respect, that they should at ced in quarantine, or wholly with- l made eligible. I submit, that, if ›ding did not wholly prevent acci- ›uld lessen their number and fear- ıences. The builders also of these l machinery would be soon taught, ıd the competition for speed and y and security had stronger claims skill. Trusting soon to see these ıder some regulation as above

m, Sir, yours, &c.,

A LOVER OF SAFETY.

ATENTS GRANTED FOR SCOTLAND 2ND OF AUGUST TO THE 22ND OF BER, 1847.

h and Alfred Blyth, both of St. Anns, Middlesex, engineers, and John of Mosemore Cottages, Old Kent-road, nist, for certain improvements in ap- distilling and rectifying. Sealed, Au- months.

White, 30, Winchester-row, New-road, .e, Middlesex, clerk, in the employ of Western Railway Company, for a new ›oducing gas, both as to apparatus, and om which the gas is produced. Sealed, four months.

ancock, of Brompton, Middlesex, gent., ments in the preparation of gutta per- . the application thereof alone and in ı with other materials to manufacturing ›hich improvements are also applicable ıtances. Sealed, August 26; four months.

Armand Lecomte Fontainemoreau, of South-street, Finsbury. English and ent-office for inventions for certain im- in steam, and other engines. (Being ›ation from abroad.) Sealed, August 31; s.

Manlove, of Nottingham Park, Notting- for certain improvements in propelling. mmunication.) Sealed, August 31; four

› be continued in our next.)

LIST OF ENGLISH PATENTS GRANTED ON OCTOBER 7, 1847.

Pierre Auguste Bassaume, of Rue du Creissant, Paris, gentleman, for a new process for the preparation and engraving of plates adapted to the printing of cotton, stuffs, paper, and other substances. October 7; six months.

Nathaniel Fortescue Taylor, of Vauxhall-walk, Lambeth, engineer, for improvements in machinery for printing and staining paper, and other fabrics. October 7; six months.

Joseph Wye, of Alfred-place, St. George's, Southwark, engineer, for improvements in machinery for driving piles and raising earth and fluids. October 7; six months.

James Pearson, of Montague-terrace, New Cross, engineer, for improvements in locomotive engines and carriages. October 7; six months.

Alexander Bain, of the Wilderness, Hampton Wick, for improvements in musical instruments, and in the means of playing on musical instruments. October 7; six months.

Sir Samuel Brown, of Vanburgh Lodge, Blackheath, knight and captain in the navy, for improvements in propelling and steering vessels, and improvements in the mariners' compass. October 7; six months.

George H. Dodge, of Attleborough, U.S., for certain new and useful improvements in machinery for spinning and winding yarn. October 7; six months.

Thomas Hunt Barber, of King-street, Cheapside, gentleman, for improvements in machinery for propelling vessels. (Being a communication.) October 7; six months.

John Tyrrel, of Great Ormond-street, Queen-square, Middlesex, esq., for certain improvements in the manufacture of elastic fabrics from vulcanized India-rubber, gutta percha, or certain fibrous materials. (Being a communication.) October 7; six months.

James Hartley, of Sunderland, glass-manufacturer, for improvements in the manufacture of glass. October 7; six months.

Jules Jean Baptiste Martin de Lignac, of Portland-street, Middlesex, gentleman, for improvements in preserving milk. October 7; six months.

Alfred Vincent Newton, of Chancery-lane, mechanical draughtsman, for certain improvements applicable to the construction of floors and other parts of buildings, and also to certain kinds of furniture and fittings for buildings. (Being a communication. October 7; six months.

Pierre Antoine Joseph Dujardin, of Lille, France, doctor of medicine, for improvements in electro-magnetic-telegraphic apparatus. October 7; six months.

Matthew Pierpoint, of Worcester, Esq., for certain improvements in the distribution of artificial light. October 7; six months.

Samuel Cunliff Lister, gent, and Isaac Holden, worsted spinner, for improvements in carding wool and other fibrous substances, and also in making heald and Genappe yarns. October 7; six months.

Richard Fell, of Winchester-street, London, engineer, and James Fell, of Ostend, Belgium, gent., for certain improvements in obtaining and applying motive power. October 7; six months.

Charles Frederick Ellerman, of Brompton, Middlesex, gent., for certain processes or methods of rendering feculent excremental and other matters inodorous and disinfecting, and also of retarding the putrefaction of animal and vegetable substances, and certain chemical re-agents employed in the said processes or methods. October 7; six months.

Matthew Townsend, of Leicester, frame-work knitter, for improvements in the manufacture of looped or knitted fabrics. October 7; six months.

LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED UNDER 6 & 7 VIC. CAP. 65.

Date of Registration.	No. in the Register.	Proprietors' Names.	Address.	Subject of Design.
Sep. 30	1211	Foster, Porter, & Co.	Wood-street, Cheapside	Cravat.
Oct. 1	1212	Richard Holland and William Turner	Sheffield	File.
4	1213	John Johnson	Leicester	Waistcoat-band or strap.
,,	1214	John Froggatt	Lenton, Nottingham, manufacturing chemist	Improved dropping dibble.
5	1215	Smith, Beard, & Co.	Cheapside	Fastening for shirt-collars, &c.
6	1216	John Slate	Wandsworth	Pneumatic chimney-top, and smoke-spreader.
,,	1217	Henry Doulton	Lambeth	Egg-shaped sewer.

CONTENTS OF THIS NUMI

LONDON: Edited, Printed, and Pu Joseph Clinton Robertson, of No. street, in the City of London.—Sold W. Galignani, Rue Vivienne, Paris; l Co., Dublin; W. C. Campbell and Co., l

Mechanics' Magazine,

[USEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 1262.] SATURDAY, OCTOBER 16. [Price 3d.

Edited by J. C. Robertson, 166 Fleet-street.

TIBBIT'S PATENT RAILWAY BREAKS.

Fig. 1.

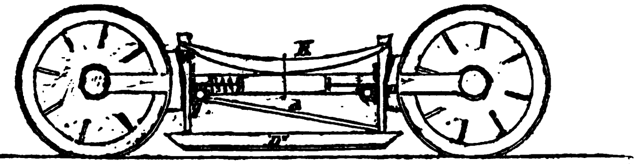


Fig. 2.

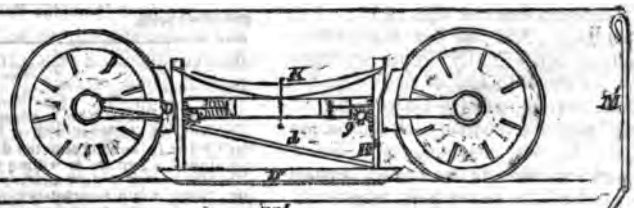


Fig. 3.

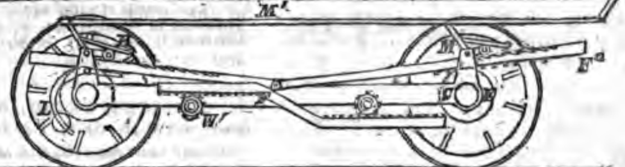


Fig. 4.

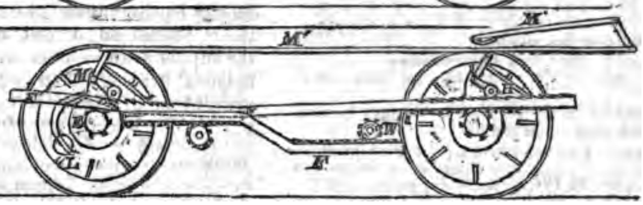


Fig. 10.

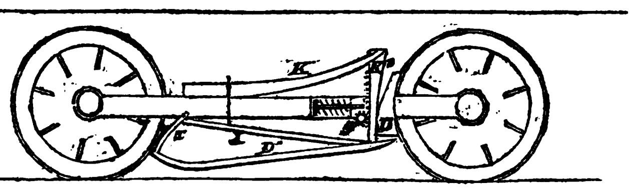
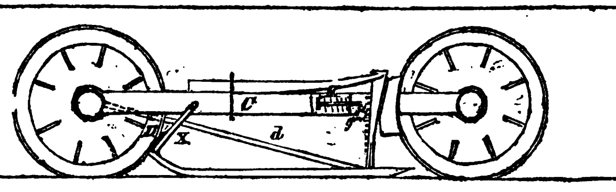


Fig. 11.



TIBBIT'S PATENT RAILWAY BREAKS.

[Patent dated March 23, 1847. Specification enrolled September 23, 1847.]

If railway carriages still run into and override one another,—are every now and then killing a passenger or two and wounding and disabling unrecorded numbers—it cannot at least be said that it is the genius of invention which is at fault. For every accident, there are seldom fewer than some score or two of remedial inventions instantly presented to the public; some with no better recommendation than their own merits, some with a name only to recommend them, and some with sanction even as high as that of the Great Seal. Alas, for your simply benevolent or benevolently simple inventors! Alas, for the authority of the Great Seal and its worshippers!—Your "Railway King" points to the many millions of passengers he has conveyed, with but an average loss of some one or two per million; and asks you scornfully, whether you are aware, that though there were no accidents whatever on railways, it would not affect your chance of living to any given age, by more than half a minute or so at the most. What can you say to such adroit home thrusts as these? How reach the sympathies of a calculator of human risks, so business-like, and yet so heartless and so cold? Be your scheme what it may, it has no chance with such people. And so it may be, that while now adding another to the many ingenious plans suggested for controlling the transit of railway trains, we may possibly be only adding one more to the long roll of things, slighted because untried, and untried because they are slighted. A vicious state of things this, which it should be the province of a wise and paternal Government to reform.

Mr. Tibbit's patent embraces two plans of arresting the progress of railway trains; but both distinguished by the common feature of embracing a break and drag in one arrangement.

Figures 1 and 2, are side elevations; figs. 3 and 4, sectional elevations of the framework and wheels of a guard's carriage;—figs. 5 and 6, transverse elevations; fig. 7, a transverse section; and figs. 8 and 9, plans;—all showing in different positions the application. The *first* of these arrangements, A A, are the wheels; and BB, the axle; G G, are two supplementary axles, which have their bearings in the under framework, C. Eacl axles carries at its centre a c W^1, or W^2, and at its extrem small cog-wheels, *g g*. E E, ar wheels fixed on the centre of t B B, in a line with the cog-wh W^2, the barrels of which are in a spiral direction. F, is a b one part of which has the cog upper side, and another part, th the under side. F^1, F^2, are tached to the bend of the rack arms are made broader at the f and wedge-shaped, so as to fit flanged-wheels. The front ratchet teeth on the top side smooth beneath. The hind arn ratchet teeth on the top, but cog to fit into the spiral thread on th of the wheels, E E. H H, are or palls, which drop between of the arms, F^1 F^2, and preve from slipping back. D D, are th and K^1, helical springs to h back. D^1, is a drag, which is s from a spring bearing, K, by two vertical rods, K^2 K^2, wh through mortices in the breaks, racked on the inside, so as to the two small cog-wheels on th the supplementary axles, G G. diagonal braces (linked or jointe prevent the drag from being dra wards, or interfering with t wheels, and d^1 d^1, two cross which keep the drag from cc M M, are two cranked levers, with friction-wheels and palls, l the arms, F^1, F^2, are pressed v quired into the flanged wheels,] which when reversed throw the or palls out of gear. M^1 M^1, rods to draw down the levers, M operation of the apparatus is as By pushing the hand-rod, M^1, position in which it is represent 4, the levers, M M, force th arms, F^1, F^2, into the flanged E E, whereupon the rotary m these flanged wheels (which ar by the carriage wheels) causes F (to which the arms, F^1 F^{11}, nected,) to advance forward, t advance the supplementary a caused to revolve and draw down the medium of the small cog-wh

rtical rods, K^2 K^2, which force the s against the fore and hind wheels, ress the drags down upon the rail. ire weighted levers for raising the rack-arms, F^1, F^2, (only one of which is shown in figs. 3 and 4,) when the apparatus is not in use.

Fig. 8.

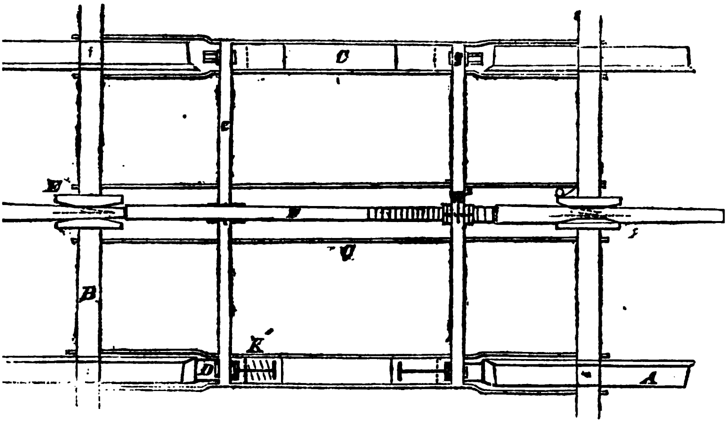
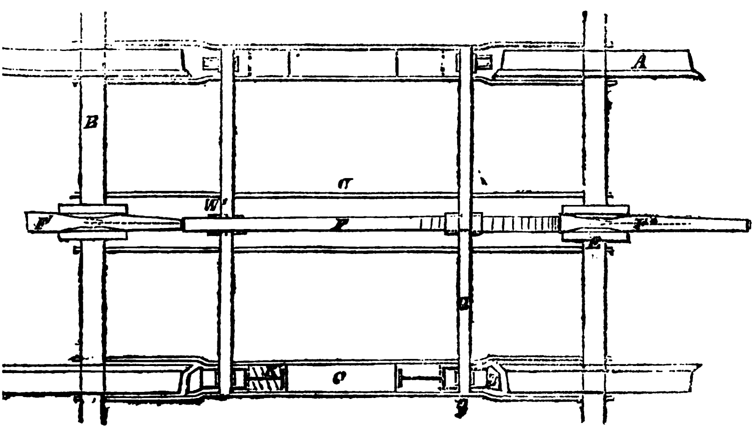


Fig. 9.



e *second* description of break and being a modification of that before bed, is represented in fig. 10 and fig. he former representing the break ag when out of use; and the latter enting them as in full operation. the drag is suspended at the front, y a strong spring-bearing, X, to the fore-break is attached, and at inder end by a vertical rod, K^2, from the free end of a spring-bearing, K, made fast to the top of the under carriage; which suspending-rod, K^2, is made of a wedge-shape (as in the preceding case), so that in descending it may press the hind break outwards against the hind wheel, and it has cogs on its inner face, which take into a small cog-wheel, *g*, attached to the end of one of the supplementary axles, G. *d*, is a

Fig. 5.

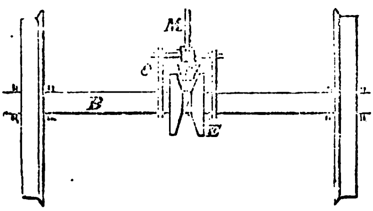


Fig. 6.

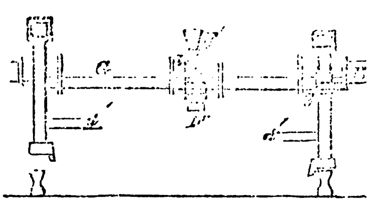
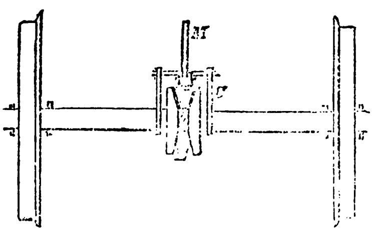


Fig. 7.



diagonal brace, which is attached at the one end to the hinder part of the drag, and at the other end by an eye-piece to the front part of the underframing. This apparatus is applied and worked in the same manner as that previously described.

ON THE EMPLOYMENT OF HEAT AS A MOTIVE POWER. BY A. H.

(Continued from page 355.)

Let us now consider more attentively the circumstances attending the conversion of water into steam. Take a vessel containing a cubic inch of water at 32° of Fahrenheit, place a thermometer in it, and apply heat. For a certain period there will be two results evidenced, a gradual but very small dilatation of the water itself, and a gradual but more easily perceptible dilatation in the n the thermometer. When the risen to 212° of Fahrenheit, .018 of its original volume, the have dilated through about .04 ginal volume. The water now boil, or, in other words, to c form, and pass into the state c Directly this commences, the of the mercury in the the stops. The heat, which up to manifested itself in two ways, i the expansion of the water *an* pansion of the mercury, now o fests itself in the conversion of into steam—or, according to term, becomes *latent;* that is, indication of its existence so f thermometer is concerned. B the heat has thus as it were ; its task apparently, it is in reali at work as ever. For that ex] the water which before was ; almost imperceptibly become point enormous. A cubic incl becomes expanded into 1,700 original bulk, being converted i cubic inches of steam. And heat is expended in doing this be sufficient to raise the same water through about 1,000°, times that weight of water thr degree.

Now, if the expansion of i were to go on at the same rate to last, that quantity of heat absorbed in the conversion into water at the temperature 212°,— is sufficient to have expanded the through 1,000 additional degre round numbers, the actual amoun heat in steam being only rougl mined as yet,) if no change of happened,—would only have the water through about .6 of it volume, (for expansion of wate $180° = 2\frac{1}{3}$ times the expansion of nearly, through the same numb grees.) Therefore through 1,000 6 times 180°, the expansion of wa $= 2\frac{1}{3}$ times expansion of mercur the same number of degrees $= 2\frac{1}{3}$ .04 of the original volume $= .6$: i calculation being merely a rough mation. Instead of the 1,700 original volume, then, we shou such circumstances, have only a sion of one-half the original volu thing can be plainer then, than t

ıt the resistance to expansion in icles of water diminishes very and may for anything we know a repulsion when a certain dis- attained. We cannot be sure he fact, however, from the mere ınce of the greatly increased rate ion; for this may be due solely eat's having less opposition to : but yet, as the dilatation of mselves proceed at a very infe- to this, it seems most probable ı a repulsion does really exist, at the instant of its first appear- also at its maximum of energy, g rapidly as the distance between les increases. During the pro- n, we have, if this be true, the wing stages:—First, a mutual ı between the fluid particles ıe heat has to overcome: this ı diminishing as the distance in- Secondly, on the cessation of , the sudden appearance of one he reverse, namely, a repulsion at first extremely great, but liminishes as the distance in- throughout its whole extent, assisting the expansive action at.

ext thing to be done, is to exa- ıether amongst the experiments ve been made, sufficient data und for determining the actual f "work done" in expanding a ıantity of water into steam as l with the "work done" in ex- a solid or a gas, by the aid of quantity of heat; and then the ive "economy" of using solids, gases, with or without change of be known. Before proceeding, to any such application of the which we have stated above, nsider the phenomenon of the n of water into steam, and the ıding effect on the mercury of aometer, in the following man- which we shall at once perceive y with a great variety of other na—an analogy which might escape observation. The ex- of the mercury in the thermo- simply the communication of om one body to another. The n the water, whilst that water n its original form of a liquid, is icated to the mercury in contact The instant, however, that, from a slow and almost imperceptible motion the action is changed into a violent and enormous expansion into steam, at that instant all motion, so far as we can see, ceases in the mercury; there is no longer that communication of motion which was so evident before. Until within the last few years we had no other palpable evidence (in relation to heat, at least,) besides this, of what we can now show from the experiments of M. Boutigny, to be a general law in the theory of heat, and not only in that branch of physical science, but in others, and which may be thus expressed as a general dynamical theorem. *If several systems of particles be in contact with each other, each system being characterised by its own peculiar constitution, laws of force, &c.,—then, if any amount of motion be given to one of these systems, it will* not *be communicated to the other systems in such a manner as to produce any sensible motion, except within certain limits to the velocity of the original motion.* Let us see, in the first place, how the experiments of M. Boutigny illustrate this fact:—About two years ago, the members of the British Association of Science, at their Cambridge meeting, were astonished not a little to see two liquids thrown into a red hot crucible one minute, and the next turned out, by M. Boutigny, *a mass of ice*. The Londoners had the opportunity soon after of witnessing the same specimen of chemical "diablerie" at the Polytechnic; and not a few, whom nothing could convince but "touching, tasting, and handling" the ice itself, had some cause to remember it, being pretty nearly suffocated by the sulphurous acid used in the experiment. In a paper in this Magazine, (vol. 45, page 105,) I referred to some former experiments of Perkins and others, of a similar nature. M. Boutigny has gone into the subject with the greatest ardour and enthusiasm, heaping up experiment upon experiment, until he has amassed enough to make a volume, to which he has given the title of "*Nouvelle Branche de Physique ou Etudes sur les corps à l'état Sphéroïdal*," a second edition of which was published in the early part of this year; and from the value of the experiments themselves, as well as the energy and spirit with which he dashes into his subject, is one of the most interesting books that I know of. The

general character of the experiments is this:—A platinum, or other crucible, is made red hot; a drop of water, or other fluid, is dropped into it; and, instead of boiling, or "flashing off" into vapour, as might at first be expected, it assumes the spherical form, and remains perfectly quiet till the crucible is removed from the fire and *cooled* down to a certain point, when the water instantly boils, or is converted almost instantaneously into vapour. This "spherical" form M. Boutigny succeeded in giving to water at the low temperature of 142° of the Centigrade thermometer (about 287° Fahrenheit;) and he announces, as a general law, that "the temperature necessary to cause a body to assume the spherical form, is so much the higher as the boiling point of that body is higher." The author also concludes that there is no contact between the red hot crucible and the drop of liquid in it, "*à l'état sphéroïdal.*" The above-mentioned law, that the temperature at which this "*état sphéroïdal*" is assumed, is higher or lower in proportion as the boiling point of the substance is higher or lower, receives a striking illustration in the case of solid carbonic acid.

"The boiling point of carbonic acid is not exactly known, but is considered to be about −80° (Centigrade;) and I admit it to be so. This being the case, it is seen that carbonic acid must pass into the spherical state, that is to say, be repelled by all bodies having the temperature of our climate, and *à fortiori* by those of a higher temperature; now this is precisely what occurs when a small piece of solid carbonic acid is placed in the hand. There is no contact, and scarcely is any sensation of cold perceived. But if this acid be mixed with ether, and it be thrown upon the hand, a severe *burn* is the immediate consequence of this dangerous experiment. The following is the explanation of this fact:—The ether added to the carbonic acid places itself in equilibrium of temperature with that body; but as ether requires the temperature of at least + 60° to pass into the spherical state, and the temperature of the human body is only about +37°, it follows that the ether, which is of the temperature of the carbonic acid, comes immediately into contact with the hand, whence the burn from the instant subtraction of caloric." (Page 6.)

It has long been a received that if any number of bodies of temperatures be placed in an each one will communicate its each of the others, and receive t return; so that if sufficient allowed, the whole of them will length the same temperature. sometimes referred to more par under the name of "Prevost's T Exchanges;" but the same vie have been taken of the matter b every one from their daily exp Now this law, though expressi actually occurs under most ordi cumstances, and for those temp with which we are chiefly conc daily life, is shown most clearl Boutigny's experiments to be n applicable beyond certain limits perature. Some of the expe proving this fact, are here quote own words:

"C'est des expériences qui préc j'ai tiré ces conséquences audacieuse *libre du calorique et l'équilibre de tem istent pas pour les corps à l'état sp* Voici comment je crois avoir mis doute la vérité de ces deux propos 50ᵉ expérience.—On prend une c fonte de 0ᵐ. 12 de diamètre enviro 4 inches) et on la fait rougir; on y 100 à 150 grammes d'eau distillée or 4 oz.) qui passent immédiatemen sphéroïdal, ou plutôt à l'état ellips plonge au milieu de l'ellipsoide la b thermomètre, et l'on observe la mar colonne de mercure qui oscille en et + 98°, mais qui reste stationnaire lorsque l'ellipsoide n'est point agit courant de vapeur qui le traverse. a d'une part, la température de + l'autre, celle de 700 à 800 dégrés: ment il n'y a point d'équilibre de * * * * * 51ᵉ. expérience.- rougir la chaudière, et l'on y ver grammes d'eau distillée; puis on un thermomètre de telle manière puisse pas toucher le sphéroïde, n en approche le plus près possible. alors la colonne de mercure monte ment depuis la température ambiant je ne sais combien de dégrés, car momètre qui était gradué jusqu'à s'est brisé, par suite de la dilata mercure au delà de ce terme. On tera que c'est au rayonnement du cette température est due; mais cela pas être, car rien ne s'oppose à ce vapeur ne se mette en équilibre

vase, et c'est en effet ce qui a lieu, cela va être démontré dans un in- Dans cette expérience, comme dans i précédent, point d'équilibre de point d'équilibre de tension.—52ᵉ. ce.—Reprenons l'expérience précé- moment ou le thermomètre marque rsons assez d'eau froide dans le r faire passer l'eau à l'état liquide, ons la colonne de mercure. Aussi- eau a cessé d'être à l'état sphéroï- bouille vivement : la capacité de la se remplit de vapeur, et le ther- descend tout-à-coup à +100°. ce resultat? parceque l'eau, en 'être á l'état sphéroïdal, rentre et er tout l'appareil sous les lois de e de chaleur." (Pages 51 and

act the following experiment, as illustration :—"A hollow sphere l or porcelain, having a hole in some point of its circumfer- heated to whiteness. Ten or rammes of anhydrous sulphurous poured into it, and immediately mometers, prepared beforehand, duced; the bulb of one is plunged spheroid of sulphurous acid id the other is held a few centi- above it. The latter instantly +300° and breaks, *the other to eleven degrees below zero.*" ese, and the immense number of periments recorded in the work, e one simple fact evidenced— ication of motion from a heated another body so long only as the of that motion does not *exceed* a imit. This fact is of the same s the non-communication of mo- he mercury of a thermometer in with water at the instant and he process of its conversion into But, as we have before said, the is not confined to the phenomena The vibrations of air constitut- nd, do not communicate any notion to solid bodies, those vibra- emselves being most probably of ptible dimensions. The vibra- the medium of light do not icate any sensible motion to the ny other solid body. Now, when nce moderately heated expands unicates motion to the mercury rmometer, it must itself be in When therefore we see this ication all at once cut off, and the mercury remaining quiet, whilst yet we know the quantity of heat given to the substance to be increasing, we are justified in concluding that the substance is still in motion, and not only so but also in much more vehement motion, and that by the constitution of elastic systems, this motion can no longer be communicated as before, so as to produce a visible motion of translation. In support of this opinion, I will now give an experiment of Franklin's, showing clearly the non-communication of motion from one medium to another in a case where such would naturally be expected.

Franklin's letter, containing an account of the experiment, I quote entire—as it is impossible to describe it more clearly than in his own words; as indeed may be said of everything that thoroughly straightforward and clear-headed man ever wrote:—"During our passage to Madeira, the weather being warm, and the cabin windows constantly open for the benefit of the air, the candles at night flared and run very much, which was an inconvenience. At Maderia we got oil to burn, and with a common glass tumbler or beaker, slung in wire, and suspended to the ceiling of the cabin, and a little wire hoop for the wick, furnished with corks to float on the oil, I made an Italian lamp, that gave us very good light all over the table. The glass at bottom contained water to about one-third of its height; another third was taken up with oil; the rest was left empty, that the sides of the glass might protect the flame from the wind. There is nothing remarkable in all this; but what follows is particular. At supper, looking on the lamp, I remarked that though the surface of the oil was perfectly tranquil, and duly preserved its position and distance with regard to the brim of the glass, the water under the oil was in great commotion, rising and falling in irregular waves, which continued during the whole evening. The lamp was kept burning as a watchlight all night, till the oil was spent, and the water only remained. In the morning I observed, that though the motion of the ship continued the same, the water was now quiet, and its surface as tranquil as that of the oil had been the evening before. At night again, when the oil was put upon it, the water resumed its irregular motions, rising in high waves

almost to the surface of the oil, but without disturbing the smooth level of that surface: and this was repeated every day during the voyage. Since my arrival in America, I have repeated the experiment frequently, thus: I have put a packthread round a tumbler, with strings of the same, from each side, meeting above it in a knot at about a foot distance from the top of the tumbler. Then putting in as much water as would fill about one-third part of the tumbler, I lifted it up by the knot, and swung it to and fro in the air; when the water appeared to keep its place in the tumbler as steadily as if it had been ice. But pouring gently in upon the water about as much oil, and then again swinging in the air as before, the tranquillity before possessed by the water, was transferred to the surface of the oil, and the water under it was agitated with the same commotions as at sea. I have shown this experiment to a number of ingenious persons. Those who are but slight acquainted with the principles of hydrostatics, &c., are apt to fancy immediately that they understand it, and readily attempt to explain it; but their explanations have been different, and to me not very intelligible. Others more deeply skilled in those principles seem to wonder at it, and promise to consider it. And I think it is worth considering; for a new appearance, if it cannot be explained by our old principles, may afford us new ones, of use perhaps in explaining some other obscure parts of natural knowledge. — Philadelphia, December 1, 1762." Here we have an undulatory motion in one medium not communicated throughout another superincumbent medium as we should have anticipated before trying.

The investigation of the general question of the communication of motion from one medium to another, offers to the mathematician a field wide and boundless as creation itself. Our systems of dynamics, so far from being completed are as yet scarcely begun, if we consider the immense crowds of phenomena in every department of nature which depend on the properties of vibratory motion. To examine the vibrations in one medium only is a problem as yet hardly entered upon; and when this is done, there remains the problem of the communication of motion from one medium to another differently constituted; and the inquiry how motions of v: give rise to motions of translat gether with the converse. But t to the subject of heat and M. Bo experiment. As a valuable elen wards the dynamical theory, an containing matter interesting to t tical man, the following res worth quoting:

"Experiment 70th.—Two sil sules are taken, of the same c $0^m.095$, (about two-fifths of a gently and equally beaten moulded), but weighing, one 2 mes and the other 200 gramme which weighs least is heate good Ælipile, and distilled poured into it with great preca order that it may be filled with the spherical state. At first t takes this spherical state, but the a moment when it moistens the boils, and rapidly evaporates. last effects are usually produced or 30 grammes of water ha poured in. The experiment is menced with the capsule weigh grammes, and it is absolutely in to moisten *it*. We may pour without precaution, sufficient it to flow over the edge of the all round, the phenomenon pers manifest itself: whence we must that *the mass or sum of materi exerts a great influence on the cal state' of bodies.* This ex is still more conclusive if peat it with three capsules of t hemispherical capacity, but o ent thicknesses. In a very thin it is almost impossible to ma than 8 or 10 grammes of wate the spherical state; a capsule of metres in thickness (.078 of may be filled with water in the state by taking some precaution capsule of 4 millimetres may b at once without being wetted. T capsules mentioned had the sa city, viz., 20 cubic centimetres more than one cubic inch.)

"Experiment 71st. — A spi with a double current, *and* thr capsules are necessary. I sha nate these three capsules by th A, B, C. They are hemispher of the same capacity (20 cubi metres.) They weigh, A, 9 gr B, 44 grammes; C, 85 gramme

of distilled water are weighed
of these capsules, one of which
l over the flame of the lamp,
invariably fixed, and the time
ration of the water noted from
nent of its being exposed to the
the heat until the whole of the
evaporated. The mean of three
nts gave,
h the capsule, A . . . 4.′ 18.″
h the capsule, B . . . 4.′ 15.″
h the capsule, C . . . 4.′ 15.″
e are results altogether unexpect
h show that the thickness of the
oilers is without influence on the
on of vapour, and this is not an
nt circumstance in practice; es-
in point of public security. Ne-
ss these results must not be
without a prudent reserve as to
lication to engine-boilers. W
it there may exist a great dif-
etween a laboratory experiment
in the factory. Who could have
riori that two capsules, so little
point of mass as A and C, would
same results, or nearly such?
assuredly. The capsule A is to
sule C as 1 to 9, 44; and this
s difference has been without
ble influence in the time of eva-
of the water. This is something
and unlooked-for. I have said
wick of the lamp was invariably
ring the whole period of these
ents: this must not be forgot-
herwise the results would no
e comparable with each other."
38 and 89.)

revent any misapprehension—it
as well to give the author's
finition of his phrase, "*état*
lal," or "spherical state:" "Bo-
jected on incandescent surfaces
maintained beyond the radius
ical action by their own vapour,
reality by a repulsive force:
tter thus modified by hot sur-
designate by the words—'*état*
al.'" I heartily concur in the
xpressed by the author: "Le
endra, je l' éspere où ces admira-
nomènes seront l'objet des études
éditations des géomètres; alors,
saurait douter, la philosophie
nces fera un pas de géant."

is one observation with regard
general problem of the commu-
of motion from one system to another, or to several others, which I will add,—and that is, that we are apt in our endeavours to form sensible notions of these very general problems, to conceive a state of things much more vague and indefinite than is the reality. The very mention of "an elastic medium," and of motions in that medium, suggests a confused jumble of unconnected motions, without anything like fixed relations or distinct results. It does not require much reflection, however, to perceive the falsity of such a notion. There may be all sorts of systems—such as air, water, or any other fluids or solids in contact with one another; each governed by its own peculiar molecular laws and constitutions, but capable of acting on the others, whilst yet each set of motions preserves its own distinctly perceptible and recognisable features. This is so obvious in such ordinary cases as those mentioned, that it would appear needless to make this remark; but the student who has endeavoured to frame something like comprehensible ideas of what may take place in such a medium as that by which light is conveyed, will acknowledge the liability to form such vague notions as those alluded to. Again; in such a case as the existence of currents in the ocean, which pursue their own course often in direct opposition to the surrounding water, one is apt, at first sight, to feel great doubts as to the possibility of such an independence of motions—whereas this and all the preceding cases are but one instance of a general law. As an example of the practical benefit to a mathematician of having acquired such notions as shall enable him to divest these phenomena of all unnecessary vagueness, I may refer to "Fresnel's Mémoire on Double Refraction," in which he applies at once, confidently and without hesitation, the laws of a vibrating string to the motion of a "line of ether," if I may use that phrase. To do this requires merely a distinct perception, that the particles of the string are no more entitled by virtue of their constitution to move together as one body, than those of the ether—that there is no more indefiniteness in one than in the other—that if our senses enabled us to witness the one as we do the other, we should never think of considering the one set of motions as one whit more vague or incomprehensible than the other. The only

difference is, that the particles are of different sizes and the forces between each pair of different magnitudes in the two cases. So also in a mass of any other elastic fluid—or even water. A whole series of perfectly distinct motions may be going on at the same time, without in any way destroying the distinctness of the others. That which we want is, the art or habit of conceiving distinctly what motions will be produced by what forces, in those cases where our senses can no longer trace them—to conceive these as clearly for indefinitely small and vibratory movements as for the motions of the planets. At any rate if we cannot, (as indeed there are very few cases in which such distinctness of conception is attained,) form such clear ideas, we sometimes require to be reminded that the vagueness exists only in our own minds; and that in nature itself every motion is as regular and symmetrical in the smallest as in the largest masses. There is one question which will naturally occur to every reader of the preceding experiments of Boutigny. At a low heat, the force would be expended in converting the water into vapour—at a highly increased heat there is no such effect: What, then, becomes of the force? What equivalent have we for it? It is not annihilated,—how then does it manifest itself? Why, obviously in the *increased light* emitted by the metal capsule or crucible: at least this is one shape into which the heat has betaken itself. It may not be, and probably is not, the only one. But until we are able to *measure* exactly the amount of force expended in producing any given intensity of light, and can also measure the force required to produce a certain expansion of mercury or of water into steam, &c., we cannot say whether the increase in the light or glow of the metal is exactly equivalent to the work left undone by not expanding the water. I take it as a principle, that force once excited or called into existence must exhibit itself undiminished in some form or other—either as light, heat, electricity, &c. It cannot be annihilated. If we see a sudden cessation of dilatation, we may expect an increase or sudden appearance of light, heat, &c. If we see the same in electricity, we may expect to find a corresponding increase or sudden appearance of some of the other forms,—magnetism, heat, &c. Set whichever of these different f may, and trace it throughout a ceeding transmutations; and always find the same absolute a force—and that force may a measured as a mechanical force as pressure or velocity.

(*To be continued.*)

DREDGE'S BRACKET GIRD

Sir,—While your correspon disputing the action of the old gir me to call their attention to the bracket girder, published in you zine, No. 1251. For it appea that the abutments of the old g powerless, and that half of its a load operating its own destr (*See* Lord Western's letter to L bourne, on Bridges, in 1841; he stated, "that this intrinsic erated its own destruction, i its self-destructive power as t is increased in length.")—In the girder, the destructive weight ship alluded to is converted in and additional length. For take the girders of a bridge or plan of 10 tons weight, 60 feet 2 feet deep, that shall be strength to bear only their own weight; the same material an without increasing the depth of ders, on the balanced bracket p will construct a bridge of t length that would sustain itsel extrinsic load, in addition, o 13 tons; besides, it possesses t strength of the truss, which can of any power the engineer plea this plan the girder and the trus distinct powers—but it is not c so; and where they depend u other for support, when either f are destroyed.

I am, Sir, yours,

MR. CRADDOCK'S HIGH-PRESSURE
SION AND CONDENSING SYST

Sir,—In the Number of the *M Magazine*, for September 25th, I fin signed "Alpha," the writer of whi to have in view three objects,—two relate to myself; and the third, to pressed-air system. In reference t vention, he admits the soundness of

ıave expounded, and also the great the same when applied to steam-

He further admits that my mode ısing is new, and that pure water lispensable element to the safe and carrying out of such principles in ssels. If to this be added the value ısing by the atmosphere, and thus ; the vacuum and pure water in merous situations in which water ırpose of condensation (and some- the use of the boiler) cannot be ob- -I say, admitting *only* this, which I the writer will not dispute with nvention will be found, in its future upon the onward progress of the gine, to hold no very insignificant ıong the accumulated products of inds, which, as combined in the gine, become a moving monument ours of its improvers even after they state of being; while at the same y in a variety of ways minister to ort and elevation of the living, and unthought-of resources to future ıns.

; thus disposed of that part of the ı which I suppose will be conceded . come to that which the writer :o would seem to desire that his should understand was but the of "arguments and plans" which, have frequently been advanced in ıdical literature during the last ten low there is, if it be true, one easy, ıg, and equitable mode of establish- detracting statement, which is, by ; us where such "arguments and re to be found. I therefore ask to ned, where the principles on which ıtion is based are so fully, and, I ırly, exhibited as in my Lectures and It can scarcely be necessary for me nally to admit that the hydrostatic the law relating to the density and of steam were known ten years ago, were made known long before then. hen, are the arguments to be found r so forcibly as in the Lectures re- the comparative security in the use ressure steam, when compared with m hitherto in practice?—where the ts that so fully unfold the effects of ı of water in the boiler with heated ove the water, and the consequences state of things in boiler explosions? 'e is the effect of motion on the cool- ondensing of the steam so clearly ? Again; as to the plans,—Where ıblic notice of Woolf's engine ar- ı any of the several modes claimed —where, valves in principle and construction similar to those given in the engravings?—where the regulating damper apparatus so effective in its operation as the one I lay claim to?—where the tubular boilers at all approaching to the safety, simplicity, and practical efficiency of those illustrated in the engravings? I ask these questions (and I may ask other similar ones) not in arrogance, but in self-defence.

I am, Sir, &c.
THOMAS CRADDOCK,

Birmingham, October 5, 1847.

MONUMENT TO SIR ISAAC NEWTON.

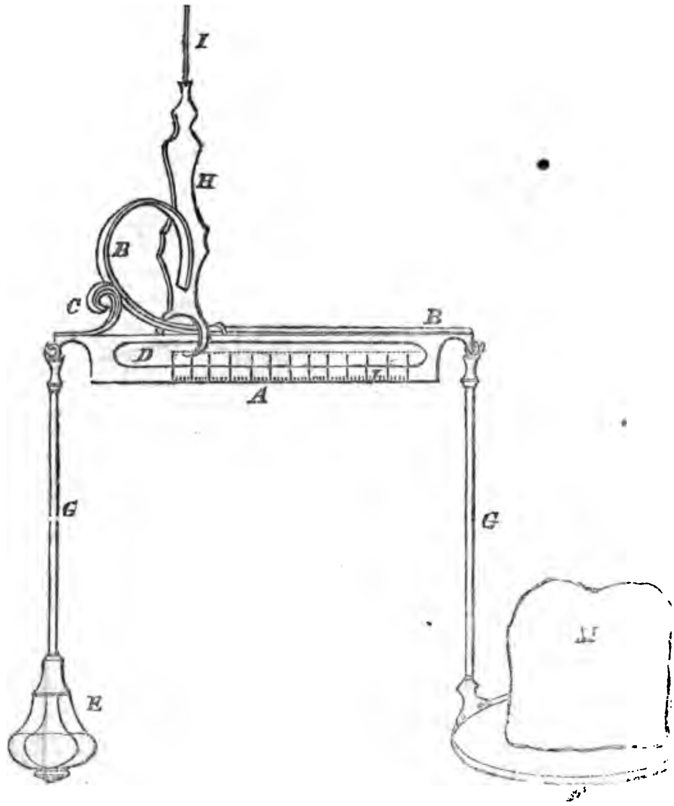
Some years back we brought under the notice of our readers an admirable proposition by our esteemed friend and correspondent, Mr. Thomas Steele, for the erection of a monument to the illustrious Newton. Although it excited at the time no small share of attention, it did not, unfortunately, lead to the desired result. Mr. Steele has now revived the project—stimulated as he owns by the success which has attended the Shakespeare Testimonial—and encouraged, too, no doubt, to undertake the task, by a laudable desire of turning to honourable account, the leisure which his late memorable retirement from the field of political strife has happily left him. We need not say how sincerely we wish him and his plan all success. We quote the following brief account of it from a letter of Mr. Steele's to the *Tablet:*

"In the year 1825 (October) I wrote from my college at Cambridge (Magdalene) a letter to the editor of the *Times*, suggesting that the House and *Observatory* of NEWTON in London should be purchased by England; and that a magnificent dome should be reared over them, just as the dome of the great church of *Assisi* has been thrown over the primitive chapel of St. Francis, to preserve them for some ages longer, as a *national monument of national glory*. I wrote another long letter in the *Times* in 1834, and had *two petitions* presented from me to the House of Commons. I made drawings, and had them lithographed and exhibited in the London print shops, and some four or five years ago I wrote a letter in the *Morning Chronicle* to Lord Lincoln, head of the Commission for the Improvement of London. My first petition, of course most elaborately and carefully written, was published in the *Sun* either in 1835 or 1836; and now that I have the precedent in the purchase of the House of Shakespeare by England as national property, I think this is the auspicious hour to work for the national monument to Newton, the greatest man, utterly and without exception, who ever lived:

"Sibi gratulantur mortales,
Tale tantumque extisisse
Humani generis decus.

"Ever yours,
"THOMAS STEELE."

"Limerick, Sept. 20.



Sir,—I inclose a sketch of a pair of Self-acting Scales, on a different principle (I believe) from any hitherto constructed, as they act without weights, excepting the one attached to the machine. If you think it worthy of a place in your valuable Magazine, its insertion will much oblige yours,

T. H. Athey.

Effingham Works, July 30, 1847.

Description.

A, represents the beam; B B, a spring placed upon the scale; C, a small spring to give strength to the large one; D, a deep groove on both sides of the beam; E, a weight attached to G; F, the receiver for the articles that are to be weighed; G G, the rods, to which the weight and the receiver are attached; H, the sliding-monitor; J, the place on the beam where the figures are plac the article to be weighed.

When the articles are put receiver, the beam B descends, other end of the beam of cour which causes the springs, B B, a push the sliding-monitor, H, for the groove D, in proportion to th of the articles in the receiver, F a person can tell by the moveme monitor on the groove of wha the articles are, by the figure J beam. The scales are thus con themselves; there can be no l weights—no impositions practise that they will weigh to the greate is almost certain, provided only th are marked and tested by correct

I am, Sir, yours,

T. H. A

promised to send you a de-
nd drawing of an artificial hand,
:e under my directions for a
residing near Exeter. Those
ıerly published in your valua-
ine were all made to produce
the action of the stump, the
; fixed to the steel rods braced
er part of the arm, above the
:. In the present arrangement,
: *constant* by means of a spring,
attached to the end of the case,
ontains the stump, and also to
ver, C, which carries an eye,
lots at D, connecting its move-
. any of the methods of grasp
n my former papers (vol. lxii.,
The lever, C, near its ter-
ɔasses through a groove in the
is flattened into a thumb-piece
When this thumb-piece is
·ward towards the wrist, the
l thumb open to receive any
' may be intended to grasp;
this pressure from the other
.en off, the grasp takes effect,
·ther effort, till released by the
ss.
purpose, there is no necessity
.rt of the apparatus, as here
ıg attached to the upper arm;
leathern cap strapped on to
will be sufficient. There is,
ne defect in applying it: the
must be taken from anything
:rform, at the time the artifi-
thus put to its work.
ıte this, and to make the act
ıy the artificial hand alone, I
the upper portion of the ap-
. this a sort of scapular flat ex-
ered with leather, E, is jointed
ıank of a small bent lever, F,
nd of which carries a grooved
·rod, G, (*see* fig. 2,) beneath
ong, thin, light metallic box,
:d several steel parallelograms,
in the instrument called the
When one of these joints is
he rest follow the movement:
nt is fastened by its pin to
of the box, H, and from the
the pin passes up through the
nnecting-rod, G, and is there
a nut. The other extremity

Fig. 1.

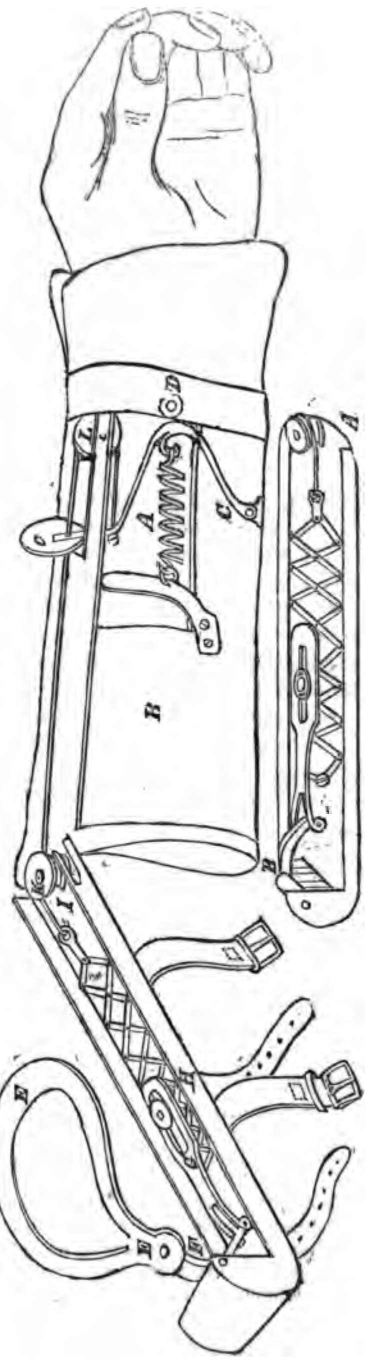


Fig. 2.

: is inverted, to show the construction
r.

carries a steel hook, I, to which a strong piece of catgut is tied;—this catgut, as a tendon, passes over the pulley, K, at the elbow-joint, and then through a groove in the thumb-piece, C, thence round a pulley at the wrist, L, and ultimately terminates in the lever, C. By this construction it is evident, that, when the flat scapular piece, E, which is placed through the arm-hole of the waistcoat, projecting from the frame or box at about an angle of 30 to 40 degrees, is forcibly compressed by the upper arm so as to bring it parallel to the box, the catgut tendon, by the elongated action the parallelogram, opens the hand, when that pressure ceases the gr commences, and continues till the pi sure again releases it. The work wit the box is protected by a light tin co and the whole apparatus weighs pounds and two ounces. This met of moving a tendon may also be app to a *direct* grasp, by having a light posing spring to open the hand till closed. I am, Sir, yours, &c.,

GEO. CAYLEY

Brompton, Sept. 1, 1847.

GEOMETRY OF THE LINE AND PLANE.—BY T. S. DAVIES, F.R.S., L. & E., F.S.A. ROYAL MILITARY ACADEMY, WOOLWICH.

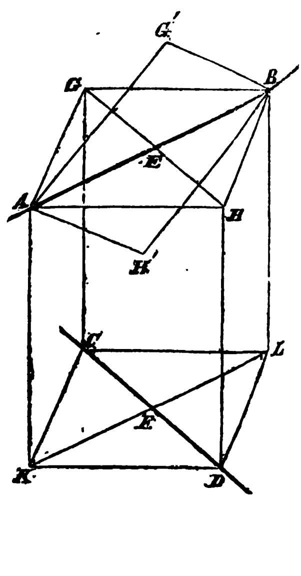
(Continued from p. 113.)

Parallel Lines and Planes.—(Continued.)

PROP. XII.

Through two given lines not in the same plane, one pair of parallel planes can be dra one through one line and the other through the other: and there can be but one p of parallel planes so drawn.

(1.) Let AB, CD, be any two lines in space, but not in the same plane; then through these there can be drawn two planes, one through each, which will be parallel to one another.



For, take any points, E, F, in AB, CD; through E draw GH parallel to CD, and through F draw KL parallel to AB. The planes AGBH, KCLD, through these pairs of lines will be parallel (*prop*. 7.)

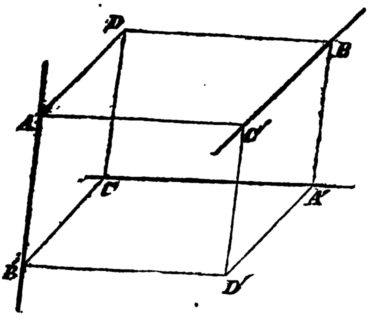
(2). There can be but one such pair: for if there can, let there be supposed to exist a second plane through AB, parallel to CD. Then since CD is parallel to AGBH and AG′BH′, it is parallel to AB, their common section, (*prop*. 9;) which is contrary to the hypothesis. Whence the plane AG′BH′ is not parallel to CD; nor, consequently, to any plane which can be drawn through it. (*ax*. 14.)

Scholium.

This proposition might have been briefly proved by means of the preceding o For it would only require that we draw through any point in space a plane paral to both the lines; then by means of *prop* 8, *cor*. 2, the possibility of one pair planes, and the impossibility of a second pair may be readily established. This va ation is, however, merely suggested as an exercise for the student.

PROP. XIII.

arallelopiped, and only one, can always be constituted, which shall have three of its non-contiguous edges coincident with three given lines in space, provided these lines be no two of them in one plane, nor all three parallel to one plane.



.et AB′, BC′, CA′, be three straight s, no two of which are in the same ıe, nor all three parallel to the same ıe: then a parallelopiped DD′ may constituted, which shall have three -contiguous edges coincident with ıe lines.

1.) For, through AB′ draw the planes), AD′, respectively parallel to BC′ CA′; through BC′ draw the planes), BD′, parallel to CA′, CB′; and ıugh CA′ the planes CD′, A′D paral- o BC′, AB′.

'hen the planes B′D, BD′, will be ıllel, (*prop.* 12.) C′D, CD′ will be ıllel; and A′D, AD′, will be paral- and these three pairs of parallel ıes will, when limited by their mutual intersections, constitute a parallelopiped. ence the theorem is true as far as the possibility of one parallelopiped is con- ıed.

2.) There cannot be a second, since only one pair of parallel planes can be drawn ıugh each pair of lines (*prop.* 12.)

[OTE.—The following six theorems are left without demonstration, in order : the student may exercise himself in this method of research independently of ıssistance.

PROP. XIV.

f any number of parallel lines be limited by two parallel planes, they will all be ıl to one another.

PROP. XV.

a line be parallel to a plane, and from any points in the line parallel lines be m to meet the plane; then these lines will all be equal to one another.

PROP. XVI.

he diagonals of a parallelopiped pass through the same point, and mutually :t each other.

PROP. XVII.

ıy plane drawn through the intersection of the diagonals of a parallelopiped to the faces of the figure not produced, will form, by its intersections with those , a parallelogram.

PROP. XVIII.

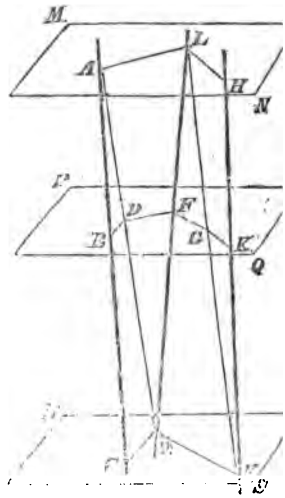
a line and plane meet one another, then every plane parallel to the plane will the line, and every line parallel to the line will meet the plane.

PROP. XIX.

two parallel lines be projected on any other plane, those projections will be lel.

Prop. xx.

If any number of lines, however situated, be cut by any number of parallel planes, will all be divided in the same ratio.



Let the three lines, for instance, AC, LE, HV, be cut by the planes MN, PQ, RS, in A, L, H, in B, F, K, and in C, E, V, respectively: then they will be divided at those points in the same ratio, so that

AB : AC : : LF : LE : : HK : HV.

For, draw planes through ABE, AEL, LEV, VHL. These will cut each other, the first two in the line AE, the second two in the line LV; and by their intersections with the parallel planes will give BD parallel to CE, DF to AL, FG to EV, and GK to LH. There are hence formed the pairs of similar triangles ABD and ACE, EDF and EAL, LFG and LEV, and VGK and VLH. Wherefore we have:

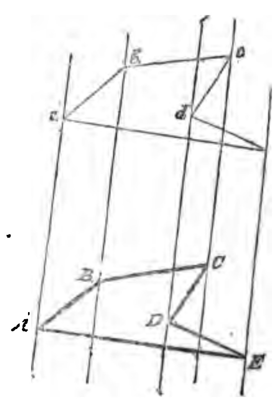
AB : AC (: : AD : AE) : : LF : LE (: : LG : LV) : : HK : KV;
whence, omitting the ratios inclosed in parentheses, we have the enunciated pro
In the same way it may be proved when there are more lines, or more plan both.

Corollary.

Conversely:—*If any number of lines, anyhow situated in space, be intercepted b two parallel planes, and all these lines be divided similarly; then the corresponding of division of each of the lines will be in a plane parallel to the two first-named on*

Prop. xxi.

Any section of a prism or pyramid parallel to the base, is similar to the base; an of the prism is also equal to the base.



(1.) Let ABCDE be the base of a prism, and let the faces be cut by a plane parallel to this base in *abcde*: then the section *abcde* will be similar and equal to the base ABCDE.

For, since the parallel planes ABCDE, *abcd* are cut by the plane A*b*, the sections AB, *ab* are parallel. In like manner *bc* is parallel to BC, *cd* to CD, *dc* to DE, and *ea* to EA. (*Prop.* 1.) Also, since the lines *ab*, *bc*, which meet, are parallel to the lines AB, BC, which also meet, the angles *abc*, ABC are equal. (*Prop.* 7.) In like manner *bcd* is equal

BCD, *cde* to CDE, *dea* to DEA, and *eab* to EAB. The two figures are therefore equiangular.

Again: since A*a* is parallel to B*b*, and *ab* to AB, the figure A*a* *b*B is a parellogram, and the opposite sides *ab*, AB are equal. (*Euc.* i. 34.) In like manner is equal to BC, *cd* to CD, *de* to DE, and *ea* to EA.

Whence the figures being equiangular and equilateral in comparison with each other, they are equal and similar.

(2.) Let the pyramid S/ABCDE (that is the pyramid whose vertex is S and base ABCDE) be cut by a plane parallel to the base; then the section *abcde* will be similar to the base.

For, as in the preceding case it may be proved that *ab* is parallel to AB, *bc* to BC, *etc.*; and hence that the angle *abc* is equal to ABC, *bcd* to BCD, *etc.* The figures are, therefore, equiangular to each other.

Again: since *ab* is parallel to AB, the triangle S*ab* is similar to the triangle SAB; and in like manner, the triangle S*bc* is similar to SBC, *etc.*

Whence,

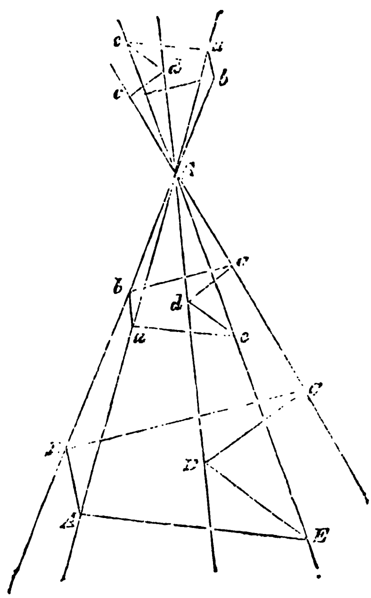
$ab : AB :: aS : AS :: ae : AE$, or

$ab : ae :: AB : AE$;

and hence, the sides about the equal angles *bae*, BAE are proportional.

Similarly, we may show that

$$\begin{aligned} ae &: ed :: AE : ED, \\ ed &: dc :: ED : DC, \\ dc &: cb :: DC : CB, \\ cb &: ba :: CB : BA. \end{aligned}$$



Wherefore the angles of one figure *abcde* being each to each equal to the angles of the other ABCDE, and the sides about the equal angles proportionals, the figures are similar to each other.

Scholium.

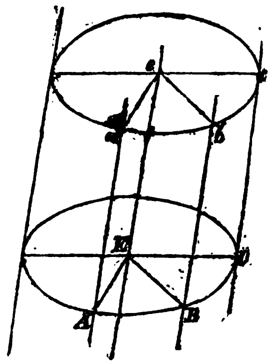
The plane parallel to the base may be on the opposite side of the base either of prism or pyramid; or again in the pyramid beyond the vertex, as in the upper part of the figure. In the latter case, however, the figure will be reversed in position.

Prop. xxii.

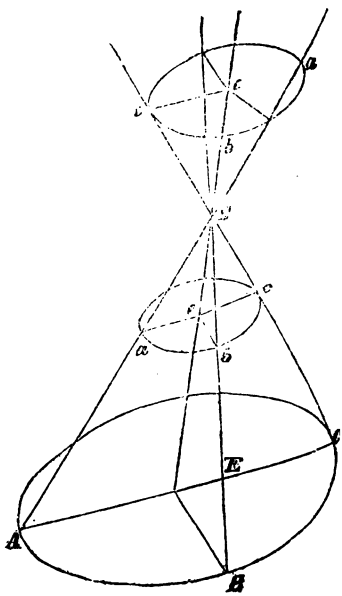
If a cylinder or cone be cut by a plane parallel to the base, the section will be a circle; and in the cylinder, this circle will be equal to the base.

(1.) Let ABC be the circular base of the cylinder, and E its centre; and let E*e* be the line through the centre parallel to the generatrices, and *e* its intersection with the plane *abc*. Let also A*a*, B*b*, be two of the generatrices, and the planes AE*ea*, BE*eb* be drawn, cutting the planes ABC, *abc* in EA, EB, *ea*, *eb*.

Then, since AE, *ae* are parallel (*prop.* 1.) and A*a*, E*e* are parallel (*def.* 11 and *prop.* 14,) the figure AE*ea* is a parallelogram, and *ae* is equal to AE. In like manner *be* is equal to BE; and similarly for any other generatrices C*c*, *etc.*



But E being the centre of the circle ABC, the lines EA, EB, EC, *etc.*, are all equal; and hence *ea*, *eb*, *ec*, *etc.*, which are equal to these, each to each, are all equal and in one plane. The section *abc* is therefore a circle, equal to ABC, and *e* is its centre.



(2.) Let S be the vertex, and ABC the base; then the section *abc* of the cone made by a plane parallel to the base ABC will be a circle.

For let E be the centre of the base, and SE the axis of the cone; and draw the planes ASE, BSE, CSE, *etc.*, cutting the parallel planes ABC and *abc* in AE, BE, CE, *etc.*, and *ae*, *be*, *ce*, *etc.*

Then, (*prop.* 1.) *ae* is parallel to AE, *be* to BE, *etc.*; and the triangles *a*S*e*, ASE are similar, as are also *b*S*e*, BSE, *etc.*

Wherefore,

ae : AE :: *e*S : ES :: *be* : BE, or,

ae : *eb* :: AE : EB.

But AE is equal to EB, and hence *ae* is equal to *eb*; and in the same way it may be shown that *ce*, *etc.*, are all equal to *eb*; and they are all in one plane. Wherefore *abc* is a circle, of which *e* is the centre.

Scholium.

The same remark applies to these figures with respect to the position of the cutt planes, as in the preceding propositions.

It may be well to remark that another series of parallel planes will, *generally*, the cylinder and cone in circles: but this is not a convenient opportunity for ferring to them in detail.

(*To be continued.*)

THE NEW BUILDING AT BUCKINGHAM PALACE.

(Second Notice.)

Flattering ourselves that our remarks on the palace did not so satisfy our readers, in the strict literal meaning of word, as to take away all inclination

again dip our pen into the tand of criticism; for there is . very great deal indeed to be much, in fact, that we must ibandon the larger share of it should they choose to touch r seem to shun as being too nd ticklish a subject. Their on may easily be guessed, be- such a case, silence becomes to condemnation; and such ill the more expressive by con- › very forcibly with the fussy, affected for the interests of rt, in the affair of the "arch ."—a good deal of which, we lp suspecting, was intended to ntion from what was about to the other end of "Constitution e that as it may, the tempest of that, from all directions, so r pelted the *improvement* of y such ungainly addition to it e equestrian figure of the Duke o have operated as a warning concerned in the alteration of :; although there was quite nough before in the decided rsal tone of contempt with ish's building had all along en of. If Nash was little to be ore is far less so, among other reasons, because architectural advanced considerably since y, when we have buildings, ugh only for MECHANICS' IN- are quite as palatial, if not in point of design and archi- haracter, as is his version or Buckingham Palace; which e-by, just been pounced upon nore facetious than merciful ary, "Punch," who, now that un, will doubtless bestow some CHINGS upon it;—(let it get as may, it will fairly deserve them severe as it seems, "Punch's" has in it too much of mere un to wound very deeply, al- regards the new front of the cuts more deeply than usual, as his caricature comes nearer to the sober truth of the mat-

e serious critics, we do not go › pronounce Mr. Blore's design mon-place as it is—positively : in itself. Had his building mmediate successor of the original Buckingham House, it might at that time have been regarded as a step—if only a single step—forward, whereas now it is not only one, but a great many steps backwards: a great many behind the architectural taste and talent in the country, as we are happy to be able to say, at the present day. If Nash's ideas, or the ideas thrust upon him, were even at that time unworthy the character of a Royal palace—the metropolitan residence of the Sovereign—Blore's are infinitely more so. By way of some excuse for the latter, it may, perhaps, be said, that the new building aims at little more than providing the increased accommodation which it seems was most urgently required, in order to render the building a sufficiently convenient habitation for her present Majesty—who, nevertheless, does not appear to find herself very uncomfortably cramped up in such a comparatively mere nutshell of an abode as Osborne House. Were such really the case, it would have been infinitely better in every respect to put the additional building as much as possible out of sight, instead of making it the principal front of the palace; since its "grand front" it most assuredly is not. In fact, the palace is not only more prosaic than ever, but is further stamped by something of plebeian quality also, there being infinitely too much of the mere "lodging-house," at least of the mere house, in its physiognomy. So far from there being the slightest architectural improvement, the edifice has been rendered of more dowdy and every-day character than ever. Poor and deficient in dignity and grandeur as Nash's structure was, it was not altogether without merit, as regarded general composition and the distribution of masses; and so far, it only required to have been executed upon a much larger scale. There was a good deal of artist-like play in the plan of the court, owing in a great measure to the manner in which the parts that connect together the main body and wings of the edifice are set back between those principal masses. Both perspective effect, and effects of light and shade, there also were; and although, as just before remarked, upon too small a scale, the *ensemble* exhibited some good, though, unfortunately, abortive elements of design. Now, on the contrary, all perspective effect is obliterated—all play of light and shade utterly destroyed; and, in its

character of palace, the building is rendered more insignificant than ever,—certainly more prosaic and common-place than originally was. What is more, and most vexatious of all, is, that the opportunity which existed about a twelvemonth ago for really improving Buckingham Palace, and rendering it—at least the park façade —a truly noble piece of architecture, is for ever lost.

Nothing whatever seems to have been thought of than merely providing, *coûte qu'il coûte*, a certain number of additional rooms—all apparently for very subordinate and inferior purposes—for lodgings for domestics, and for nurseries. Even the marble arch, which is said to have cost no less than seventy thousand pounds, is to be pulled down; not that we should ground any particular reproach of extravagant wastefulness on that circumstance, were it attended by any tolerably indemnifying advantage. Instead of which, the disappearance of the arch—no matter how much, or how little it may cost—will be a positive loss—the dismissal of an architectural feature that could ill be spared, and in comparison with which the gateway now substituted for it as the Royal, or State-entrance into the court, will be trivial and even paltry in character. Whether the feasibility of retaining the arch by bringing it into the design for the new façade, was at all discussed—whether such idea even so much as presented itself we are unable to say, there being not so much as a syllable of Report or explanation of any kind accompanying the officially published "Plans and Elevations." Left in doubt, we strongly incline to fancy, that, owing to some untoward chance, no such idea occurred either to the architect himself or any one else; for had it been hinted at all, hardly could he have experienced any difficulty in adopting it, unless he be altogether destitute of contrivance. Nor do we speak unadvisedly, since we have actually seen a design for a new park façade to the palace, in which the arch would have been preserved, and while the court would have been screened and rendered comparatively private, a view into the park from all the principal apartments around the court—which was surely a very great desideratum—would have been preserved also. The idea was to keep the arch intact, but connect it with the general line of the façade by

two sweeping convex colonnades, rants in plan,) whose order wou been in continuation with tha adorns the two fronts of the arch upon an unbroken stylobate answ the pedestals on which the last-m columns are raised. Being abo feet and a half high, that styloba have effectually screened the cou while the colonnades would ha ciently concealed the buildings rear, admitting no more than i glimpses of them set off by the perspective lines and shadows mere architectural character colonnades would have been gr hanced by the sun falling on so tion of them, and striking thr columns during the whole of while all the rest of the façad have been in shadow. The co would have been double ones, th consisting of a mere external columns supporting only their tablature—as was the case with t in front of Carlton-house, an case with the lines of colum necting the three entrance-arc Hyde-park, opposite Grosveno but having a corresponding columns behind, towards the c that the space between them wo been available as a raised and terrace walk. This *duplicity* of ation would have produced ve richness, in addition to that arisi extent; in regard to which last, namental screen, including the self, would have been rather m 200 feet. The colonnade on ei of the centre would have con eleven intercolumns, with stat candelabras for gas-burners, p them alternately, viz., five of th and six of the latter. Statues duced, while they would have an equally novel and happy effe gards the *ensemble*, would have advantage of being distinctly whereas now decorations of that almost invariably placed so far a eye that very little more than th ral form can be made out; and merit they may possess as produ art is lost and nullified. Thu of standing as heretofore, a mer ed architectural bit, the arch w connection with the proposed nades, have constituted a rich

:reen connecting two new wings,
out about 30 feet forwarder than
wings, and carried out north and
the extreme limits of the origi-
de; that is, as far as the present
.ouse, and corresponding colon-
'een on the north side arc; there-
ing two important lateral masses,
les, each of which would have
) feet in length, thus making the
:xtent of the park façade 620

out going so far as to say that
ign we have been describing—
) at least—contains the happiest
it could present itself, we may
firm that it would have imparted
ingham Palace the imposing air
eliness of a Royal residence, with-
roying or at all interfering with,
w most unluckily done, those ad-
s of situation and prospect which,
ing else, the building possessed
ne from the hands of Nash. On
trary, the prospect of the park
ave been set off in the most
and scenic manner by the open
les, and the court-yard would
oked even larger than before,
e arch, as seen from the palace
ppeared rather to stand in the
e palisading enclosing the court
ming a sufficiently distinct and
nt boundary to the eye.
king quite seriously and impar-
nd without the slightest degree
eling towards Mr. Blore per-
—who, for aught we know to the
y, may be a very estimable man,
om we should be sorry to give the
in to—the palace has now been
d a greater architectural mon-
and failure than ever. To our-
t is little less than incredible how
design as the one adopted could
ssed muster at all. We cannot
e by what stretch of complaisance
' those noble lords whose signa-
pear to it, could have prevailed
emselves to countenance what is
editable to their own reputation
of taste. Surely De Grey, the
nt of the Institute of British Archi-
d Egerton Ellesmere, must have
e unpleasant qualms of critical
ce,—if of such conscience they
y—when they set their hands to so
le a design for *improving* the re-
of their Sovereign. Perhaps it was
growing dusk at the time, and they did not see very clearly, wherefore—oh consequence most unhappy!—we shall have no other satisfaction than that of abusing the palace more harshly than ever, and exclaiming with the satirist,

> "Unhappy Britain, doom'd to be disgraced
> By Pecksniff palaces, and Royal taste!"

LIST OF PATENTS GRANTED FOR SCOTLAND FROM 22ND OF AUGUST TO THE 22ND OF SEPTEMBER, 1847.—(CONCLUDED FROM PAGE 397.)

(Concluded from page 367.)

William Pidding, of Alfred-place, Bedford-square, Middlesex, gent., for an improved process, or improved processes, for preparing certain vegetable extracts, and also for preserving the aroma of certain vegetable substances from the atmosphere. Sealed, September 1; four months.

Charles Chinnock, of Seymore-place, Little Chelsea, Middlesex, gent., for improvements in regulating motion and controlling friction in the joints, and other parts of furniture, machinery and carriages. Sealed, September 3; four months.

Arthur Harry Johnson, of Gresham-street, London, assayer, for improvements in refining silver, lead, by effecting a saving in one of the materials used. Sealed, Sept. 6; six months.

Jules Jean Baptiste Martin de Lignae, of Portland-street, Middlesex, gent., for improvements in preserving milk. Sealed, Sept. 8; six months.

Pierre Armand Lecomte Fontainemoreau, 4, South-street, Finsbury, for inventions for certain improvements in machinery for preparing cotton and other fibrous substances. (Being a communication from abroad.) Sealed, September 13; four months.

Baron Charles Wetterstedt, of Rhodeswell-road, Limehouse, Middlesex, for improvements in the manufacture of sheet metal for sheating and other purposes, in preventing the corrosion of metal and preserving wood and other materials.. Sealed, September 15; six months.

William Bacon and Thomas Dixon, both of Bury, Lancaster, engineers, for certain improvements in steam engines. Sealed, September 17; six months.

Hasimer Vogel, of St. Paul's Church-yard, London, gent., for a new manufacture of weavers harness, and machinery for the production of the same. Sealed, September 17; four months.

Robert Wilson, of Low Moor Iron-works, Bradford, York, engineer, for certain improvements in machinery, and arrangements thereof, for forging, stamping, punching, cutting and pressing metals, and other substances. Sealed, September 17; four months.

John Mollett, of Austin Friars-passage, London, merchant, for certain improvements in fire-arms, and in cartridges. (Being a communication.) Sealed, September 21; four months.

LIST OF ENGLISH PATENTS GRANTED ON OCTOBER 14, 1847.

Sir John Scott Lillie, of Fulham, Middlesex, knight, for improvements in Machinery applicable to tillage and for agricultural purposes. October 14; six months.

Thomas Horne, of Birmingham, for certain improvements applicable for carriage windows. October 14; six months.

John Thang Harradine, of Hollywell-Cum-Needingworth, Huntingdon, farmer, for an improved agricultural instrument for preparing land in various ways for agricultural purposes. October 14; six months.

David Fisher, of Clerkenwell-green, for improvements in the manufacture of boots and shoes. October 14; six months.

Francis Lloyd, of Snow-hill. London, tobacco manufacturer, for certain improvements in the preparation and manufacture of tobacco. October 14; siv months.

Matthew Curtis, of Manchester, machinist, for certain improvements in machines used for preparing to be spun and spinning cotton and other fibrous substances, and for preparing to be woven and weaving such substances when spun. October 14; six months.

Bartholomew Beniowski, of Bow-street, Covent-garden, Middlesex, for certain improvements in the apparatus for and process of printing. October 14; six months.

Joseph Maudslay, of Lambeth, Surrey, for certain improvements in the manufacture of candles, parts of which improvements are applicable to the manufacture of other moldable substances. October 14; six months.

Alfred Vincent Newton, of 66, Chancery-lane, Middlesex, for an improved machinery for blooming iron. October 14; six months.

Arthur Wall, of India-row, East India-road Middlesex, for a new or improved apparatus for and method of separating oxides from their compounds, and each other. October 14; six months.

Robert Stirling Newall, of Gateshead, Durham, for certain improvements in machinery for grinding grain, paints, and other substances. October 14; six months.

LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED UNDER 6 & 7 VIC. CAP. 65.

Date of Registration.		No. in the Register.	Proprietors' Names.	Address.	Subject of Design.
Oct.	7	1218	Paul Garbanati............	Newman-street, Oxford-street...	Refractio reflexa.
	8	1219	George Wilson............	The Glass-works, York	Improved stopper.
	9	1220	John Rogers and Son...	Broad-street, Birmingham	Non-metallic flexible connector, for garters, braces, and waistcoat-backs.
	,,	1221	Laidlaw and Sons	Simons-square, Edinburgh	Economic gas stove.
	,,	1222	Edwin Sherwood.........	Birmingham.........................	Fastening for button-case.
	,,	1223	Joseph Horatio Cutler,	Birmingham.........................	Hook for fastening articles of dress.
	,,	1224	Edward Varney Pledge,	Cheapside, Birmingham	Papier maché handle for whips.
	11	1225	Henry Brigg & Son.....	29, Leicester-square, London	Truss for Hernia.
	12	1226	Thomas Debenham Mills	Frederick-place, Goswell-road...	Measuring-machine.
	,,	1227	John Stafford.............	Stratford, Essex	Tricoloured railway lamp.
	,,	1228	William Smith	Gresham-street	Safety pin and needle-box.
	,,	1229	Bloomer & Phillips.....	Rockingham-lane, Sheffield......	Spring brace-pad with lever thumb-bit.
	,,	1230	Thomas Tring.........	Norfolk-street, Lower-road Islington	Decanter brush.

all working purposes, and decidedly eco-

Haslingden, September 4, 1847.
,—We have now been using the Gutta aps for the last eight months, and have ure in saying they have answered our tine expectations; and we may add, that r machines which required a 12-inch lea- and which almost daily required to be e have been turning the same with the ha Straps 10 inches only for the above- od, and now find them as good as the ere first applied.
We remain, yours respectfully,
W. & R. TURNER.
ıtham, Esq., Gutta Percha Company.

tlas Works, Manchester, Sept. 1, 1847.
reply to your inquiry as to the result of ence with the Gutta Percha Straps, we pleasure in stating that the advantages ıs are so very manifest as to induce us to ı in almost every instance where new 'equired.
We are, Sir, very respectfully,
SHARP, BROTHERS.
ıtatham, Esq., Gutta Percha Company.

Bridgewater Foundry, Patricroft, near
Manchester, Sept. 3, 1847.
reply to your inquiry respecting how we iutta Percha Machine Straps or Driving ough we have not had quite so much in the above-named use of Gutta Percha to have, so far as we have employed it, n us general satisfaction. The beauti- ht and regular manner in which it runs leys, especially on our cone or speed pul- .rong recommendation in its favour; and 'e are inclined to think it does not take ip on the pulley as leather, yet there is for all general purposes. We shall con- e it and to give it our best attention, so how to employ to best advantage the llent qualities it possesses over the ordi- ır belts.

NASMYTH, GASKELL, & CO.
am, Esq., Gutta Percha Works, London.

Manchester, 18th June, 1847.
,—We beg to inform you that we have ıe patent Gutta Percha Bands or Straps nore than six months. For tube frames ır them very much superior to anything ried before. They also do very well as ı for mules, throstles, looms, &c.
ı, Sir, yours respectfully,
THOS. DODGSHON & NEPHEWS.
uel Statham, Gutta Percha Company.

Wellington Mills, Stockport,
4th September, 1847.
en,—We have much pleasure in bearing ıny to the valuable qualities of the Gutta driving bands. We have found it answer y well in most cases where we have tried think it has only to be made known to very general use.
Gentlemen, yours obediently,
IOLE, LINGARD, & CRUTTENDEN.
utta Percha Company,
ty Road, London.

ottington Hall, near Bury, Lancashire,
September 3, 1847.
,—Your letter of the 31st August is to in answer respecting the use of your cha Bands, I cannot give you a better r approval of them in preference to lea- than having given an order for another 'tner, yesterday, to be in readiness in case t. They are decidedly preferable to the and we can recommend them with the nfidence to any person for Driving Straps.
ALL & GORTON, THOMAS GORTON.
ım, Esq., Gutta Percha Company.

Brewery, 16th September, 1847.
Gentlemen,—We have much pleasure in repeating our testimony to the very great improvement effected by the use of Machinery Bands made of your material instead of leather: the stoppage of parts of our works, through the failing of the leather straps, used to be of daily occurrence, causing great inconvenience and expense. With this annoyance we are now never troubled, and are assured by our superintendent that the advantage of using your material is surprising, as regards economy and saving of trouble. We confidently recommend it to machinists and factories for general adoption.
TRUMAN, HANBURY, BUXTON, & CO.
To the Gutta Percha Company.

Gutta Percha Soles for Boots and Shoes.

The capabilities of the GUTTA PERCHA SOLES FOR BOOTS AND SHOES having been extensively and satisfactorily tested, we can unhesitatingly recommend the material prepared for the purpose, its merit having been acknowledged by all who have worn it. Indeed, experience has proved that Gutta Percha Soles wear twice as long as leather, with great additional personal comfort, and they remain perfectly impervious to wet until quite worn through.

23, Southampton Row, 1st Sept., 1847.
Gentlemen,—I write to thank you for allowing me to use the new PATENT GUTTA PERCHA SOLES. I felt annoyed at not being allowed to use them from the time I had first worn them, namely, from last October, but am not sorry now, because I can speak confidently of their advantages over leather soles. I made the first pair last October, and wore them eight months before I wore the soles through. I had them heeled six times, and one pair of extra fronts I put to the same soles. *I only kept the one pair in wear to see how long they would last.* I will never wear another leather sole so long as I can get GUTTA PERCHA SOLES, and I walk from 12 to 20 miles a day.
C. WRIGHT, Boot and Shoe-maker.
To the Gutta Percha Company.

9, Gloucester Row, Hoxton, 5th July, 1847.
Sir,—I beg to thank you for the boots with GUTTA PERCHA SOLES which I had from you on the first of the year. I have had them in constant use for nearly five months, the greater portion of that time being the most inclement period of the year; and from my occupation as a general post letter-carrier, you may be sure that they have had more than a common fair trial, and the Gutta Percha seems now as firm and as little worn as on the first day.
W. HUTTON, G. P. O. Letter Carrier.
To E. Granville, Esq., Gutta Percha Works.

28, St. John-street, August 25th, 1847.
Gentlemen,—It gives me great pleasure to acquaint you that the Gutta Percha Soles I had from your Works have answered the purpose admirably, as I can fully testify, having had them in wear six months, during the winter, in Smithfield-market, and have not been subjected to the annoyance of wet feet, as is often the case with leather soles, and, in my opinion, they wear three times as long.
H. I. TARLING.
To the Gutta Percha Company.

N.B.—The above Soles, which are not worn out, may be seen at the Gutta Percha Company's works.

Galoshes, Tubing of all sizes, Bougies, Catheters, and other SURGICAL INSTRUMENTS; MOULDINGS FOR PICTURE-FRAMES and other decorative purposes. WHIPS and THONGS, TENNIS, GOLF, and CRICKET BALLS, are in a forward state of manufacture, and will be very shortly ready for sale.

All orders forwarded to the COMPANY'S WORKS, WHARF-ROAD, CITY-ROAD, will receive immediate attention.

CONTENTS OF THIS NUMI

LONDON: Edited, Printed, and Pu Joseph Clinton Robertson, of No. street, in the City of London.—Sold W. Galignani, Rue Vivienne, Paris; Co., Dublin; W. C. Campbell and Co.,

Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 1263.] SATURDAY, OCTOBER 23. [Price 3d.

Edited by J. C. Robertson, 166 Fleet-street.

MESSRS. CLARKE AND BARBER'S PATENT IMPROVEMENTS IN THE MANUFACTURE OF LOOPED AND WOVEN FABRICS.

Fig. 3.

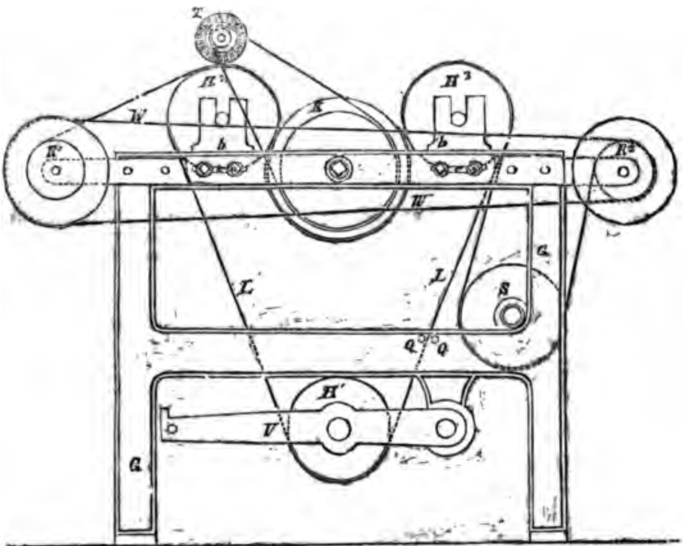
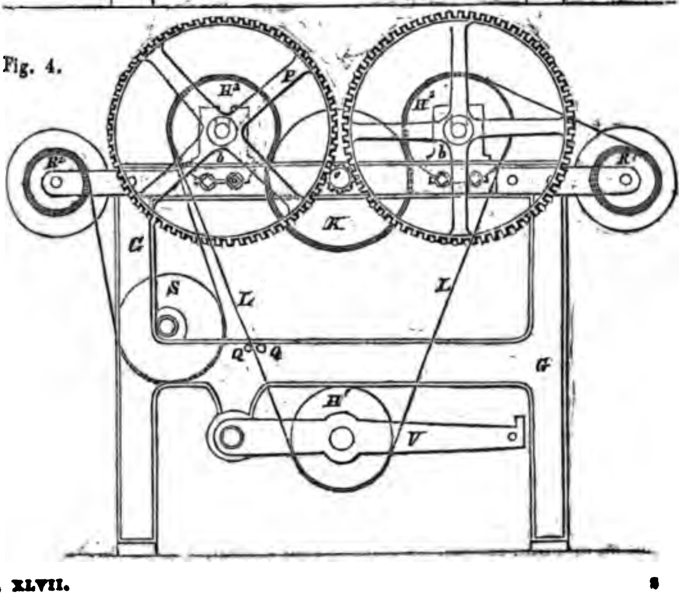


Fig. 4.



MESSRS. CLARKE AND BARBER'S PATENT IMPROVEMENTS IN THE MANUFACTURE OF LOOPED AND WOVEN FABRICS.

[Patent dated February 8, 1847. Specification enrolled August 8, 1847.]

THE present patent embraces three things:—1st. An improvement in the processes employed in pressing and getting up hosiery goods (looped fabrics.) 2nd. An improved mode of oiling black hosiery; and, 3rd. An improved machine for pressing and finishing woven fabrics generally. All of them are well deserving of attention; being manifestly real and great improvements in the processes to which they refer.

1. *Hosiery Goods' Pressers.*

According to the method of dressing and getting up stockings and other hosiery goods now in ordinary use, the goods after being dried are placed between *rigid* press-papers or mill-boards, and submitted for a time to pressure. Messrs. Clarke and Barber substitute for the rigid press-papers or mill-boards *yielding* or *elastic* pressers, composed of caoutchouc or gutta percha, in one or other of the states of preparation or combination afterwards specified, which yield readily, without any cracking of surface, to whatever inequality of thickness there may be in the goods subjected to pressure, and impart to them therefore a more uniform gloss and finish than paper or mill-board, or any other like rigid substance is capable of doing. They make these improved pressers either of caoutchouc which has been previously sulphurised, and is commonly known by the name of "vulcanized caoutchouc;" or of gutta percha, which has been sulphureted or vulcanized in a similar manner to caoutchouc; or of ordinary caoutchouc coated with a solution of gutta percha; or of gutta percha, which has by continuous kneading or by the intermixture of other substances, such as caoutchouc or French chalk, been brought to a state of elasticity; or of thin sheets of caoutchouc or gutta percha in any of the said states of preparation or combination, cemented to backings of woollen or cotton cloth or felt, or some other like soft material; or finally, of woollen or cotton, or any other textile fabric coated on one or both sides with a solution of gutta percha, or first with a solution of caoutchouc and then with a solution of gutta percha.

The materials so prepared or combined, are either fitted to revolving cylinders, or formed into cushions filled with air, and the goods passed between them under pressure; or to flat tables, boards, or plates, to which vertical pressure is applied. The goods may be pressed either with or without shapes or forms being introduced into them. The pressers moreover may be either used in a cold state, or have any requisite degree of heat imparted to them by making the cylinders or tables, or boards or plates, to which they are fitted hollow, in order that steam or hot water may be admitted inside, to effect the required heating; but where they are required to be of a temperature exceeding blood heat, those pressers only should be employed which are formed of sulphurised caoutchouc or sulphureted gutta percha.

2. *Oiling Black Hosiery.*

At present black hosiery is commonly oiled by hand: Messrs. Clarke and Barber do this by an apparatus of the description represented in figs. 1 and 2, A^1, A^2, are two rollers which are mounted in suitable bearings, and are made to revolve by bands carried from a steam-engine, or any other convenient first mover. These rollers are made of wood covered with some elastic material which will not absorb oil or be injuriously affected by it, or with some elastic material which is an absorbent of oil or affected by it, but is protected by a non-absorbent outer covering. The patentees prefer using for the purpose of covering such rollers gutta percha sheeting or sulphurised caoutchouc. Common caoutchouc sheeting may be used for an under covering, with an external envelope of stout calico or cotton; or an under covering may be employed of cotton or woollen cloth, protected by an external covering of gutta percha or sulphurised caoutchouc. B^1, B^2, are two oiling-rollers which are made to revolve by frictional contact with the rollers, A^1, A^2. C, C, are funnel-shaped reservoirs for containing oil, each of which communicates at bottom with a pipe, D, which is perforated on its under surface with numerous holes which open into a linen, cotton, or woollen bag, E,

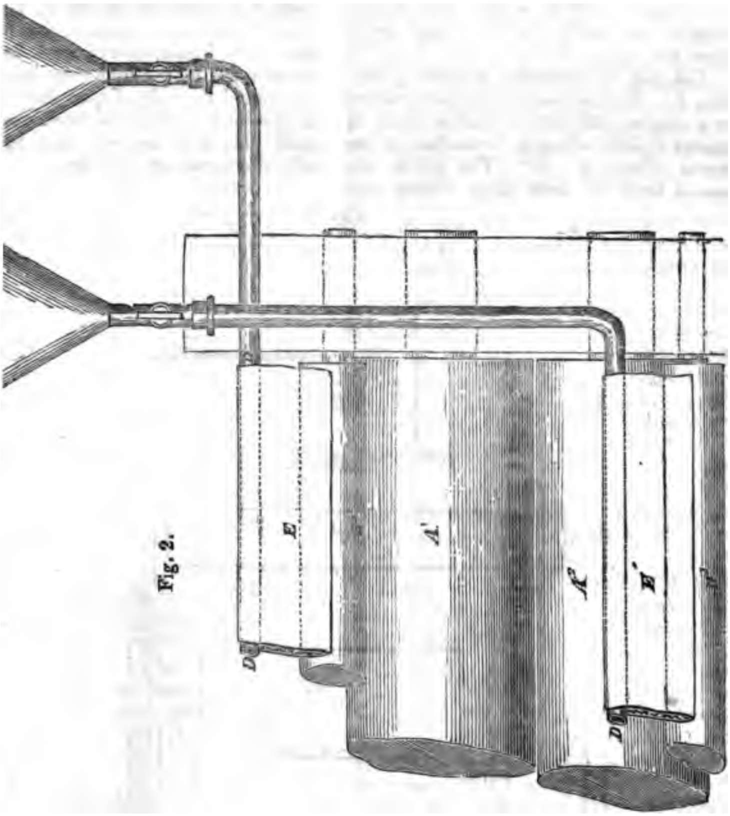


Fig. 2.

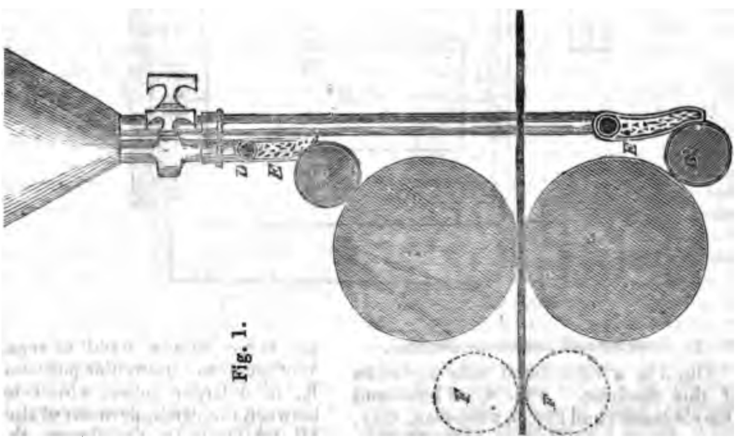


Fig. 1.

suspended from the pipe; which bag is filled, or nearly so, with saw-dust or any other material which will readily absorb and retain the oil which drops from the pipe.

The bag, E, rest upon the sliding-rollers, B^1, B^2, and keep them always oiled to a degree sufficient to enable them to impart a slight oiling to the surface of the larger rollers, A^1, A^2. The goods are passed between these large rollers, and thus oiled at once on both sides. When the goods require or would be improved by brushing as well as oiling, as is the case with black cotton hosiery, the patentees place two brushing-cylinders in such a position behind the rollers (as indicated by the dotted lines, fig. F), so that the goods as they emerge from between the rollers, shall pass next between and in contact with the brushing-cylinders.

Fig. 6.

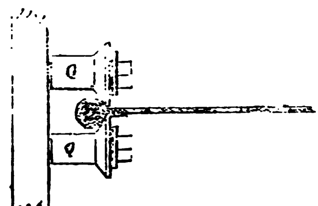
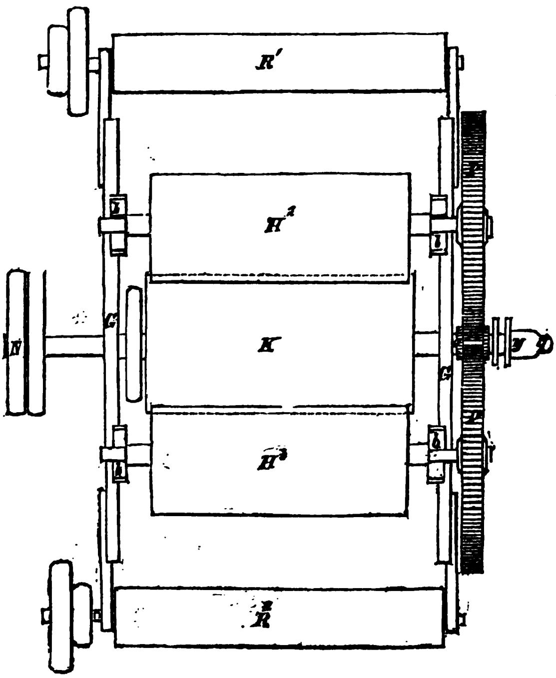


Fig. 5.



3. *Pressing and Brushing-Machine.*

Fig. 3 is a right-hand side elevation of this machine. Fig. 4, a left-hand side elevation; and Fig. 5, a top plan. GG, represent the framework. H^1, H^2, H^3, are three rollers, fixed as regards one another in the triangular position shown. K, is a larger roller, which is placed between the two uppermost of the rollers, H^1 H^2 H^3. In the figure, the roller

represented as being about half of ameter of the rollers, H, lower but it may be placed either higher er according as it is desired, to the goods impinge against the as afterwards explained) through a or larger portion of its periphery. s an endless web, without seam, passes from the undermost roller, er the top of H^2, then under K, nce over H^3, and is kept from ig or twisting by two or more pieces, Q Q, on each side, (a pair ch are shown separately on an d scale in fig. 6,) which catch two raised hems, formed by turner the edges of the cloth and g a cord between the doubled The bolts, *a a*, which secure the s, *b b*, of the axles of the rollers, ^{3}, in their places are passed i horizontal slots, *c c*, in the frame-which allows of these bearings, nsequently of the rollers being t more or less close to the centre K, according to the thickness of ds that are to be pressed. When ler (K) is required to be used t is heated by steam introduced i the axle, (the same being made for the purpose) and connected by ig-box, *y*, and pipe, *g*, to a steam-or by iron heaters inserted through s in the ends of the rollers. pulley. M, the right hand-end of i of the centre roller, K, which is ed in the usual way to a steam- or other first mover. O, is a on the left-hand end of the axis which gears into and gives motion toothed wheels, P P, which spectively attached to the left-nds of the rollers, H^2, and H^3. mbers of the pinion and wheel rly as 1 to 6½, so that the rates d at which they respectively re- may vary in these proportions, orresponding degree of friction uced between the centre roller (K) e goods. (These numbers may ed according as either more or ction is required.) R^1, is a cloth from which the goods to be are delivered to the machine. R^1, they pass atop of the endless over the roller, H^2, then under K, er H^2; from which last they are under and (partly) around a S, (kept cold by being filled with ter or some refrigerating mixture, or by causing a stream of water or cold air to be directed through it) and then finally wound on a receiving-roller, R^2. It is a band which cements the cloth beam, R^1, and the roller, R^2. In passing over H^3, the goods are brought in contact with a brushing-cylinder, T, mounted immediately over it, which is done by a belt on the pulleys, L^2, L^3; but this brushing-cylinder may be removed when not required for particular sorts of goods. V, is a lever attached to the end of the axis of the roller, H^1, (which axis is inserted in slotted bearings, to admit of its being lowered to any extent required) by attaching weights more or less to the end of which lever a corresponding degree of depression of the roller and increase of tension on the endless web will be produced. The receiving-roller, R^2, instead of being attached to the machine as shown, may, if preferred, be placed at some distance from it.

ON THE EMPLOYMENT OF HEAT AS A MOTIVE POWER. BY A. H.

(Continued from page 380.)

Before quitting the subject of M. Boutigny's experiments, I will quote the following, in addition to the preceding extracts:

"I think we may deduce from the preceding experiments this remarkable law:—The temperature of bodies in the spherical state, whatever be that of the vessel containing them, is invariable, and always lower than the boiling point of the substance: to this it is proportional, and, for water, is 96°. 5″. . (page 12.) 100 degrees on the Centigrade scale, it will be remembered, is the boiling point of water. When this 'état sphéroïdal' has been assumed, the evaporation goes on but slowly. (Those who choose to make the experiment, which is as simple as it can be, will be amused at the rapidity with which the little spherical drop moves about, not unlike a pendulum, and becoming 'small by degrees and beautifully less,' until it vanishes.) Let the temperature of the capsule or containing vessel, however, be *lowered*, and off it goes into steam. The possibility, and even probability, of the water in the boiler of an engine assuming this peculiar condition, and whilst the sides of the boiler may be red hot, the water giving off little or no vapour, will be obvious to every one. M. Boutigny himself contends very strongly for this being one of the chief causes of boiler explosions. The following sentences will suffice to convey his opinions:

"Let us now examine the third theory (as to boiler explosions), which is founded on the laws of the 'état sphéroïdal.' Here the facts speak, and they speak loudly. If water be put into a trial-boiler, and it be submitted to a high temperature, the water will speedily boil forcibly, and give off torrents of vapour. If the feeding is neglected through any cause, and the boiler gets red hot, the water which may then be introduced will possess new properties. *It will not moisten the sides of the boiler*, it cannot become of a higher temperature than 98°. (208°. Fahrenheit,) and will *consequently give off but very little vapour*. (It was observed on board the *Citis* that the steam escaped at a very low pressure a moment before the explosion.) But if the fire should be put out, or reduced—or else, if all at once there be introduced a great quantity of cold water into the boiler—in either case the water will spread itself over the sides of the boiler, will moisten them, and be instantaneously converted into steam; and its tension, under most circumstances, may become equal to a thousand atmospheres."

It appears that the celebrated chemist Dumas had long before announced the same thing; and M. Boutigny, with an anxious wish to do justice to every one, has recalled the circumstance, and quoted from Dumas's "Treatise on Chemistry Applied to the Arts" the following passage:

"However it may be, the fact is incontestable, and ought to serve as a caution against the dangers incurred by allowing a boiler accidentally to acquire a very high temperature; for it might happen that there would be no longer any vapour given off, and yet, nevertheless, a lowering of the temperature cause an explosion. Plates of fusible metal are especially useful against this sort of danger, since they limit the temperature which the apparatus can acquire; for it is evident that a safety-valve would no longer be lifted at the instant when this singular phenomenon manifests itself. This sort of accident will be rare in ordinary boilers, but it may become very frequent if the use of generating tubes becomes more common. These tubes containing only small quantities of water, and being usually raised to a sufficiently high temperature, it will be easy to reach the point necessary for the production of the phenomenon we have been mentioning." (Tome 1, p. 32.)

M. Boutigny proceeds:

"This cause of explosion would have long since occupied the attention of engineers and experimenters, if it had been recognized sooner that,

"1st. Water in large masses may assume the '*état sphéroïdal*.'

2nd. That this phenomenon may be produced at the temperature of + 171°. (340°. Fahrenheit.)

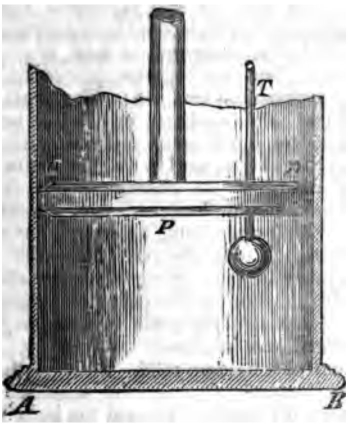
"3rd. That the equilibrium of heat is never established between the water in its spherical state and the boiler, and that this equilibrium constantly exists between the vapour furnished by the spheroid and the boiler in which it has been generated. But experiments being indispensable to make these facts still more apparent, I shall now describe some which will show that I have advanced nothing but what is exact and true.—Experiment 39.—A hemispherical capsule has some grammes of water poured into it, and heat applied by a good double-current spirit lamp: the capsule becomes heated, and transmits the heat to the water, which begins to boil at + 100°. Arrived at this temperature, the capsule acquires no higher temperature, and the whole heat becomes latent in the vapour. We know that the equilibrium of heat is the law of the phenomenon thus briefly described; that is to say, the contained and that which contains are constantly at the same temperature. When the ebullition is tumultuous, and there remains but little water in the capsule, drops of water are thrown up into the air, and fall back to the bottom in the spheroidal state. If now water, even in the state of boiling, be poured in the capsule, it no longer boils, and its temperature rises no higher than + 96°. 5, whilst that of the capsule may rise indefinitely. Here is one of the most curious phenomena which can be seen, and which alone would be sufficient to modify profoundly the theories of heat: but I have said I shall leave the theory aside. It is almost superfluous to add, that the law of equilibrium of heat is not applicable to this particular case, and that sooner or later this want of equilibrium must be taken into consideration. Things being in this state, if we pour in all at once a large quantity of water (some grammes,) it spreads itself over the capsule, and evaporates almost instantaneously; or else, if instead of pouring in large quantities of water, we extinguish the lamp, the capsule on cooling loses its repulsive force; the water repasses to the ordinary liquid state, and evaporates, causing an explosion. In these two cases the equilibrium of heat is re-established." (Pages 45 and 46.)

Those who feel interested in these experiments of M. Boutigny, will, no doubt, refer to the book itself for further information. My object in giving these extracts, is to place somewhat fully before the reader different illustrations of

examples of the same general law—communication of motion in a visible form, and non-communication in such a form, according as certain limits are or are not passed, by the addition of heat continuously to a substance. As a still more general illustration of the same law, I gave Franklin's experiment; (without any reference however to the question of *velocity* as having anything to do with the non-communication of motion,) and, were it not wandering from my immediate subject, more could be added.

I will now state a few "problems," as a sort of specimen of the manner in which the various questions in the subject of heat may be stated in a form which may probably be found useful.

PROBLEM I.—In a cylinder with a movable piston, APD, a mass of air is enclosed, the thermometer, T, indicating the temperature of the enclosed



air. Heat is applied, so as to raise the temperature of the air in the cylinder: and, in the first place, the piston (being loaded with a given weight) is allowed perfect freedom of motion, so that the confined air may expand; in the second place, the piston is kept fixed in its original position. It is required to find the degree of dilatation of the mercury for a given quantity of heat supplied in these two cases: in other words, it is required to find the ratio of the specific heat when the *pressure* is constant, to the specific heat when the *volume* is constant. The "quantity of heat" supplied may be measured, or rather the two quantities in two experiments *compared* in several ways. If a spirit lamp, or any other source of heat, give forth its heat uniformly, then the *time* during which it is applied to the apparatus, will serve our purpose. For the sake of having a distinct measure for the quantity of heat used in any experiment, let us assume as our standard the quantity of heat obtained by the consumption of one pound of pure carbon (which, according to the combining chemical equivalents will unite with 1⅓ pounds of pure oxygen to form carbonic oxide, if the supply of air be restricted, or with 2⅔ pounds of oxygen when there is a free supply of air.) This "quantity of heat" being taken as the unit, the number of units, or the whole quantity of heat used in any experiment may be denoted by C; and all that we want to know or recollect about it, is, that it will be a constant quantity throughout any calculation:

If A denote the mutual attraction or pressure between any two particles of the mercury at any instant, the integral $\int A\, dr$ between given limits would express the work done in dilating the mercury through a certain number of degrees, or fractional parts of its original volume. But this may be expressed in a more convenient form. Every definite integral, as is well known, is equal to the difference between the limits multiplied by some value of the variable intermediate between the least and greatest values: or, in other words, any sum.

$$Px + P'x' + P''x'' + \ldots\ldots\ldots$$

$= (P + P' + P'' + \&c\ldots). \times$ some *mean* or intermediate value of x between the greatest and least.

P, P′, P″, &c., being of the same sign.

The work done therefore in expanding any two particles of mercury from their original distance (r) where the mutual pressure was P to another distance (r') where the mutual pressure is P′, may be expressed by either of the terms; $(P - P') \times$ a mean value of (r), or by $(r' - r) \times$ a mean value of P. The latter expression is most convenient in considering the expansion of the mercury.

Let the mercury dilate through one degree, the volume changing from V to V′, and the distance between each pair of adjacent particles from r to r'. As this change of distance, owing to the expansion, does not depend on the *shape* or form which the form of the tube compels the mercury to assume, we may suppose the original volume, V; to be of the form of a cube, and to become an-

other cube of volume, V', by a symmetrical expansion in each edge of the cube—the number of particles in each edge being (n). Then $V = n^3r^3$, $V' = n^3r'^3$, and the dilatation for one degree, or the fraction which the increment of volume is of the original volume, namely, $\frac{V'-V}{V} = \frac{r'^3 - r^3}{r^3}$. And if R denote the mean pressure between each two contiguous particles during this expansion, the work done in expanding these two will be $R(r'-r)$; and the whole work done in expanding the whole mass, will be this quantity multiplied by the whole number of particles.

In the case where the air in the cylinder is at liberty to expand, and raise a piston loaded with a weight, P, let the space through which it is raised by the application of the given quantity of heat, C, be denoted by h. Then

$$C = Ph + n.R(r'-r).$$

Again: in the second case, where the air is not allowed to expand, but can only produce an increased pressure against the piston, let the integral expressing the sum of all the increments of pressure occasioned by the application of the same quantity of heat as before, C, be equal to the weight, P, raised k feet, and let the corresponding increment of mutual distance in the particles of mercury be $(r''-r)$. Then

$$C = P.k + n.R.(r''-r).$$

$$\therefore\ P(h-k) = n.R(r''-r').$$

If V'' denote the increased volume of the mercury in the second case—(that is when the volume of air remains the same, and the distance of the particles of mercury changes from r to r'')—

$$\frac{V'}{V''} = \frac{r'^3}{r''^3} \text{ or } \sqrt[3]{\frac{V'}{V''}} = \frac{r'}{r''}.$$

Hence since V' and V'' are known quantities, the ratio of r' to r'' is known: (h) and (k) are also known, and (n) is proportional to the weight of the mercury in the thermometer which is used. We have, then, in the above equation three unknown quantities, and at present only one relation between two of them.

In very delicate experiments, and possibly in others of a rougher character, the mass of the mercury ought to be taken into account, and also the weight of the column, when the instrument is placed vertically. The "mean resistance" to expansion cannot be assumed to be the same in any two successive degrees: but it appears from experiment that it is nearly uniform for all ordinary temperatures, but becomes extremely variable towards either extremity of the scale, namely, towards the boiling or freezing points of the mercury. Just as in water, and in short all other substances, when a change of state from solid to liquid or liquid to gas, is about to occur, the mutual attraction diminishes very rapidly, and most probably in all cases gives place to repulsion. "It frequently happens in some northern climates that the mercury freezes in the thermometer. When this was first observed, it excited some astonishment that the mercury, at the moment it became solid, fell suddenly through a considerable range of the instrument, and was often altogether precipitated into the bulb. It was hence inferred that the cold capable of freezing this metal must have been enormous, and that it answered at least to $-570°$ Fahr. But this estimate proceeded on the supposition that the sudden contraction of the mercury in cooling arose from the same cause, and was attributable to the same law as the ordinary variations of the thermometer. This excessive cold, however, was rendered extremely improbable by several obvious effects. It was observed that when the mercury in the thermometer was about $-38°$, it was on the point of congealation, and that the great contraction just noticed was produced suddenly at the moment it became solid. Between these two instants of time, the sensation of cold with which it affected the body was not sensibly different; and yet if the great change of temperature indicated by the sudden fall of the mercury were real, it cannot be supposed that some considerable effects would not be produced on the senses. All doubts upon this subject, however, were completely removed by a beautiful series of experiments, executed in Hudson's Bay, by the directions, and with instruments furnished by Mr. Cavendish." From which it was easily seen, "that the temperature of the mercury during congealation was really that which the thermometer suspended in it indicated during that process, and that the extensive and sudden contraction of the mercury in the thermometer, on becoming solid, was an instantaneous effect, not of change of

rature but of the transition of uid to the solid state." (*Lardner's tise on Heat*, pp. 132 and 3.)

s is obviously the same kind of effect sudden expansion of water into . If once the contiguous parti- f any substance be placed beyond hin certain limits, the law of their l attraction or repulsion immedi- alters. And the forces thus sud- developed are generally far more etic than any external forces which applied.

return to the Problem. It is ob- that there will be more heat re- l to expand the mercury through gree, when the air is also expanded same cause, than when the mer- lone is acted upon in that way,—in words, the specific heat of air a constant pressure is *greater* than the air maintains a constant vo- The reason is clear enough: the air is free to dilate, the heat is absorbed in doing this, and ab- l in such a way that the mercury influenced by it: whereas when ston is fastened down, and there is dually increasing pressure against sed by the air seeking to expand —this pressure is transmitted by re- to the mercury, and dilates *it*. rocess is precisely the same as in ther case of the transmission of mechanical force. When the parts of the machine by whose agency the trans- mission is made, are all perfectly rigid or unable to give way, there is no loss of the useful or intended effect (leaving out friction); but when the parts of the machine can themselves be put in mo- tion, the power applied is partly ex- pended in so doing, and there is a pro- portionate diminution in the motion of every other body to which the force was intended to be transferred. Here the mass of air may be considered the ma- chine, and the expansion of the mercury, the effect intended to be accomplished by the application of a certain quantity of heat. If the air dilates itself, it em- bezzles that which was intended for another, and swallows down what it cannot give up again. But if it re- mains firm at its post, the piston re- turns the pressure exerted upon it, and this re-action is communicated without loss or hindrance to the mercury in the thermometer, which accordingly receives all the benefit of it and the conse- quences are shown by its rising in the tube. When the quantity of heat sup- plied is the same, the specific heats in any two cases are inversely proportional to the dilatations of the mercury produced. Therefore in our present problem, since we have supposed the quantities of heat (C) to be the same,

$$\frac{\text{Specific heat of air (pressure constant)}}{\text{Specific heat of air (volume constant)}}=\frac{V''-V}{V'-V}=\frac{r''^3-r^3}{r'^3-r^3}.$$

value of this fraction by experi- is considered to be about 1.417 mmon air.

OBLEM II.—To find the relation en the specific heats of two differ- ibstances.

ere will be two cases here, as in the ding question; the first being that ich the specific heat is found for a nt pressure, and the second case, constant volume. Let us take for ple two different gases, such as on air and hydrogen. Let equal es of these be successively en- in a cylinder loaded with a nt pressure as before, and the ity of heat (C) applied: the cor- nding dilatations of the mercury e inversely as the specific heats of vo gases. Let the piston be raised gh (h) feet for one gas, and (k) or the other. Also denote by R mean resistance to expansion be- tween each two particles of the mercury, and by N, the number of these particles in the thermometer employed, and let the increments of their mutual distance be, $(p'-p)$ and $(p''-p)$ for the two gases respectively:

Then, $C=P.h+N.R.\,(p'-p)$. for one gas;
$C=P.k+N.R\,(p''-p)$ for the other.
$\therefore\ P(h-k)=N.R\,(p''-p')$.

If the two gases expand equally for the same quantity of heat, as is found to be the case by experiment, (or at least so nearly that the variations may be attributable to errors of observation,) then $h=k$, and therefore $p''=p$, or, in other terms, the dilatation of the mercury are the same for the two gases; that is to say, the specific heat of two gases, equal volumes of which are taken and kept under equal pressures, are themselves equal. This is confirmed by experiments of MM. De la Rive and Marcet, and also those of Dulong, for what are termed the *simple*

gases, but not for all. (*Vide* Lamè Cours de Physique de l'Ecole Polytéchnic, tom. i., Lecon 18; and Pouillet Eléments de Physique, tom. ii., pp. 499 and 503, last edition). It is worthy of inquiry how far the variation from this law in the compound gases may be consequent upon the variation of their *dilatability;* for it is on this, as we have just seen, that the difference in the specific heat depends.

In solids and liquids the specific heat has always been measured for a constant pressure. It seems very probable that if the *volume* were constrained to remain constant, *i. e.*, if the solid or liquid were prevented from dilating, then the specific heat would be found to be the same for all substances.

Let us now take equal weights of two different solids or liquids; let A denote the mutual attraction of the particles of one, and B the same for the other, (that is, as we all along suppose, the mean pressure throughout the limits of the experiment). Let (n) and (m) denote the respective numbers of particles in the two masses, and $(r'-r)$, $(s'-s)$ the respective increments of molecular distance. Then, as before,

$$C = nA\,(r'-r) + N.R\,(p'-p),\ \text{for one substance;}$$
$$C = m.B.\,(s'-s) + N.R\,(p''-p).\ \text{for the other.}$$
$$\therefore\ nA\,(r'-r) - m.B.\,(s'-s) = N.R.\,(p''-p').$$

Let us now see what other relations there exist between the different quantities contained in this equation: $(r'-r)$ and $(s'-s)$ are proportional to the linear dilatations of the two substances. Also, since in equal weights of the two substances, the number of particles is inversely proportional to the weight of each particle, if we assume the weight of each particle to be proportional to the "chemical equivalent" of that substance; (as is so generally done, the chemical equivalent being, in fact, frequently called the *atomic weights*, though after all we have no certainty for this): then,

$$\frac{n}{m} = \frac{\text{atomic weight of substance } (m)}{\text{atomic weight of substance } (n)},$$

denoting for the sake of brevity, by "substance (m)", that in which the number of particles is (m). Thirdly, $(p''-p')$ is a function of the specific heat or corresponding expansions of the mercury in the two cases. But it will be much more convenient to introduce the different quantities of heat (C) and (C′) required to increase the temperature by one degree, into the formulæ directly, then to consider the different dilatations produced by the same quantity of heat, as in the last equation.

Let then the work done in expanding the mercury through one degree be denoted by W; then,

$$C = nA\,(r'-r) + W$$
$$C' = m.B.\,(s'-s) + W.$$

$$\therefore\ \frac{\text{Specific heat of substance } (m)}{\text{Specific heat of substance } (n)} = \frac{C'}{C} = \frac{mB.\,(s'-s) + W}{nA\,(r'-r) + W}.$$

The quantity, W, may be made as small as we please, by only applying heat in very small quantities, so as to dilate the mercury through an exceedingly small fraction of its volume: but at the same time he should of course diminish the quantities $(s'-s)$ and $(r'-r)$. We may, however, by taking in the experiment very large masses of the substance compared to the mass of the mercury, make W as small as we please compared to the other terms in the above ratio, without affecting the ratio of the specific heat. [Therefore, at any rate as an approximation, we obtain,]

$$\frac{\text{Specific heat of substance } (m)}{\text{Specific heat of substance } (n)} = \frac{mB\,(s'-s)}{n.A.\,(r'-r)}.$$

If now, as is highly probable, the increase of distance between the particles be inversely proportional to the attractive force, that is, if

$$\frac{s'-s}{r'-r} = \frac{B}{A},\ \text{then } B\,(s'-s) = A\,(r'-r).$$

And we obtain the following relation immediately,

$$\frac{\text{Specific heat of substance } (m)}{\text{Specific heat of substance } (n)} = \frac{m}{n} = \frac{\text{Atomic weight of substance } (n)}{\text{Atomic weight of substance } (m)};$$

or, *the Specific Heats are inversely as the Atomic Weights,*

which is the celebrated result of the experiments of Dulong and Petit. The

following Table, as the result of their experiments, was given by these distinguished experimenters:

Specific Heat. Specific Heat of Water = 1.		Relative Weight of Atoms. Oxygen = 1.	Products of the Atomic Weights × by Specific Heat.
Bismuth	0.0288	13.30	0.3830
Lead	0.0293	12.95	0.3794
Gold	0.0298	12.43	0.3704
Platinum	0.0314	11.16	0.3740
Tin	0.0514	7.35	0.3779
Silver	0.0557	6.75	0.3759
Zinc	0.0927	4.03	0.3736
Tellurium	0.0912	4.03	0.3675
Copper	0.0949	3.957	0.3755
Nickel	0.1035	3.69	0.3819
Iron	0.1100	3.392	0.3731
Cobalt	0·1498	2.46	0.3685
Sulphur	0.1880	2.011	0.3780

It will be easily seen by the preceding investigation from what causes the ratio of the specific heats as determined by experiment may be expected to differ from the exact inverse ratio of the atomic weight, in any one experiment, namely, by the addition of a small quantity (W) to the numerator and denominator of the exact ratio. In *different* experiments the results will be different, according as the masses or quantities of the substances experimented upon are larger or smaller *as compared with the quantity of mercury in the thermometer.* The whole inquiry is obviously one of *approximation.* The experimental results of Dulong and Petit are not in *accurate* accordance with the law announced. From the quantities used by them for experimenting upon, as compared with the small mass of the mercury in the thermometer, a tolerably near accordance with the results which would be given by the preceding formula, may be reasonably expected. There would also of course be slight or even considerable variations arising from the *different methods* fixed for determining the specific heat, *e. g.* by the method of mixtures, calorimeter, &c., &c. If the principle of the preceding investigation be correct, one obvious benefit would consist in pointing out the circumstances which may give rise to these variations from the exact law, and serve to correct them.

ON THE EXPANSION AND CONTRACTION OF BODIES BY HEAT. BY WM. DREDGE, ESQ., C.E.

Sir,—The expansion and contraction of bodies, particularly metallic bodies, from the effects of heat, present a physical problem for our consideration of great importance in construction. With the following remarks on this subject I propose to trouble your readers.

Every one knows that bodies expand on the application of heat, but the law which governs their dilitation has not that I am aware of been sufficiently defined to enable us to deduce general results from it. Experiments have been extensively made, but they serve only to establish the relative expansion at any given temperature, without being sufficient to determine the law on which it proceeds.

It is however certain, that the dilitation of a body is not in proportion to the addition of temperature; for equal additions of heat will not produce equal increments of expansion.

Most persons must have observed the effects of unequal expansion on various materials when injudiciously applied; and engineers and others engaged in construction are well aware of the impossibility of restraining such a force, and make provision for the free expansion, and contraction in all structures, where this variation is likely to be attended with injurious results.

The force with which a body expands or contracts, on the application or abstraction of heat, is equivalent to a mechanical force extraneously applied which shall produce a similar effect; so that by ascertaining by experiment the linear dilitation of a body, at any given temperature, we may obtain by calculation an exact measure of the force which that temperature calls into operation.

" The steeple of Bow Church has, within the last few years, been nearly thrown down by the alternate elonga-

tion and contraction of some iron bars built into it" *

The deflection of the chains of a suspension-bridge is greater in the summer than in the winter months, and the crown of the arch of a bridge built of cast iron rises, giving a greater versed sine in hot than in cold weather. In both these cases the roadway yields to the pressure, and no injury is produced; but if any attempt were made to restrain this force, the effect would be most destructive.

In all bodies, whether they are solid or in parts, and made solid by construction, any unequal contraction either produces disruption, or so weakens the structure that it is insufficient to resist the force it was intended to do. This is one reason why cast iron can be so little depended on, and why it is exceedingly injudicious to calculate the dimensions according to the formula given by investigation, and to adhere strictly to them; for it is impossible in a casting of any variety of section,—some forms of girder for instance,—that all parts can cool together, and that they should therefore contract alike. Those parts which become cold first have necessarily to resist the contraction of the other parts whilst cooling: this, in some cases where the difference of section of metal is very great, even passes the limits of tenacity; and the casting when taken from the sand is found ruptured. In all cases of unequal cooling this must have the effect of reducing the limits of elasticity, and must therefore weaken the girder, and lessen its power to resist extraneous pressure.

If an iron wire of small section were firmly fixed to two abutments and stretched during summer, it would contract in the winter, and not being able to move the abutments, would weaken the wire, but if an iron bar of several inches section were substituted for the wire, no abutments, however strong, would be able to resist it—the force of contraction being directly as the section.

I have observed above, that the force exerted in the expansion or contraction of a body may be measured by a mechanical force capable of producing the same effect.

Therefore if l=the length of a bar of iron of any section, K M=the modulus of elasticity and $\overline{\Delta l}$=the expansion of the bar at the temperature, v, then the force of expansion is represented by this equation:

$$F = \frac{MK.\overline{\Delta l}}{l} \ldots\ldots\ldots\ldots\ldots (1.)$$

Thus, if $t=76^\circ$ then $\overline{\Delta l}=0005$, if $l=1$ (Phil. Trans., 1813) and F = 30000000 K × ,0005 = 15000 K giving a pressure of 15000lbs. on each square inch of section; thus if K were so small that this force might be restrained, the limits of elasticity would be reduced two-thirds, but if K became = several inches, then, no abutment could restrain its force of contraction. If $t = 212^\circ$ then $\overline{\Delta l}$=,001158 (Smeaton) and F=30000000 K×, 001158=3474 K, which is beyond the limits of elasticity.

If x = any segment of $\overline{\Delta l}$, then $F_1 = \frac{MKx}{l}$, and $\frac{MKx}{l}\Delta x$ = the work done by the expansion through the extremely small space $\overline{\Delta x}$; whence, passing the limits and integrating between $x=0$ and $x=\overline{\Delta l}$.

$$U = \tfrac{1}{2}\frac{MK\Delta l^2}{l} \ldots\ldots\ldots\ldots\ldots (2.)$$

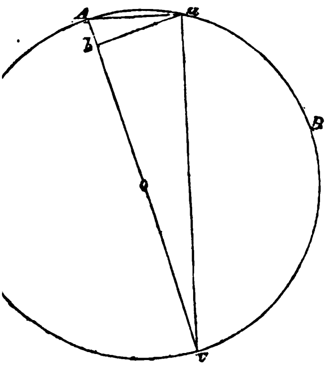
It is very evident therefore that the effective work done by expansion or contraction may be applied to useful purposes in the arts, where great force is required to act through a very small space; as in riveting boilers, iron ships, tanks, &c., hooping casks, and fixing the tires on wheels, &c. The force of shrinking, as it is termed, is here brought most usefully into play. If r=the radius Ao of the red-hot tire, ABCD, (fig. 1,) x=Aa any small space on the periphery Δx the quantity, Aa, would shrink in cooling; then by equation (1) the force exhibited in the space, Aa=F$=\frac{mK\overline{\Delta x}}{x^2}$, resolving the force into F_2 acting in the direction Ao, we have F_2=

* Not within the "last few years," but a long while ago; and the cause was supposed at the time to, be not "the alternate expansion and contraction, but the accumulation of rust on the iron bars. The incident is thus referred to by Dr. Wilson, Phil. Trans., 1764: "At its erection the builder had employed near the top of the spire, for additional security, several iron cramps; the ends of which by being exposed to the weather became rusty, swelled, and so much enlarged thereby as to raise the stones above them, and to deflect the top of the spire six inches from the perpendicular. Danger being apprehended from this situation, the spire was taken down several feet of its length and properly repaired." ED. M. M.

$$\frac{\overline{FAb}}{x} = \frac{MK.\overline{Ab}.\overline{\Delta x}}{x^2} = \frac{MK.\Delta x}{2r}$$

se by a well known property of the

Fig. 1.



$x^2 = 2r.Ab$; therefore the amount ce in the direction Ao is

$$F_2 = \frac{MK.\Delta x}{2r}.—$$

ı, if Δx become $=\Delta 2r\pi$ the total ressive force throughout the whole hery, is

$$= \frac{MK.\overline{\Delta 2r\pi}}{2r} \text{ .... } (3),$$

he work, U, done by the tire in ıg,

$$= \tfrac{1}{2}\,\frac{MK\,\overline{\Delta(2r)^2\pi}}{2r} \text{ .... } (4).$$

eading " A. H.'s" valuable paper in last Number, the following thoughts red to me, which, though I do not hem borne out by calculation, may theless be worthy of record.

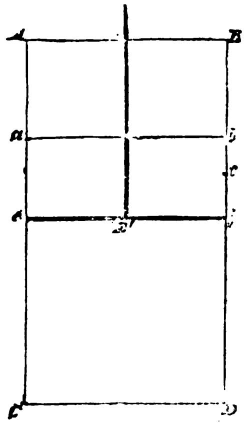
e experiments of Œrsted proved vater is compressible to the extent 0047 of its bulk on a pressure of one phere, or 15 lbs. per square inch, hat for each additional atmosphere ressure is increased, an equal addi- f compression is produced.

; ABCD (fig. 2,) be an exceedingly ; cylinder filled with water to the $a\,b$, and suppose it possible by the ation of immense pressure to the ı, E, to compress the water to the $e\,f$. Put P = the force on each e inch of the piston when the water ught to the level, $e\,f$, D$b=a$, $bf=\beta$, r, and area of piston$=$K, then,

$$47 : 15 :: \frac{\beta}{a} : P = \frac{15\beta}{.000047a}, \text{ and,}$$

$\frac{15\beta K}{.000047a}$ = the upward pressure on the

Fig.



piston at $e\,f$, or the upward pressure at any point $c = \frac{15\,Kx}{\cdot000047}$; whence, inte- grating between $x=0$, and $x=\beta$, we obtain an equation for the work done by the piston during the time of compres- sion.

$$U = \tfrac{1}{2}.\frac{15\,K\,\beta^2}{.000047a} \text{ .... } (5).$$

Now if the cylinder be filled to the level, ef, with water at 32°, and by the application of heat be raised to a tem- perature of 212°, and then have ex- panded to the level, ab, the work done by the expansion of water is

$$U = \tfrac{1}{2}.\frac{15K\beta^2}{.000047a}.—$$

because it is equivalent to the work done by the mechanical force employed to produce the compression just enunci- ated.

The experiments of Despretz show that 16 oz. of oxygen combined either with carbon or hydrogen, will raise 30 lbs. of water from 32° to a temperature of 212°; and as 1 lb. of water at 32°$=$27 cubic inches nearly, 30 lbs.$=27\times30=810$ inches. Hence, if $K=1$, $a=810.$, and $\beta=810\times.0433=35.07$ inches, (because water dilates in bulk .0433 on being heated from 32° to 212°), and the numeri- cal value of U is

$$U = \tfrac{1}{2}.\frac{15\times35.07^2\cdot K}{.000047\times810} = 485486. \text{ lbs. raised}$$

one inch high, or $\frac{485486}{12}=40457$ lbs. raised one foot, and as the same amount of work is due to the force of the contraction in cooling, the total of the work done by 1 lb. of oxygen operating on 30 lbs. of water, the temperature of which it is just able to raise from 32° to 212°, is $=40457 \times 2 = 80914$ lbs. lifted one foot high.

1 lb. of coals, or $2\frac{1}{4}$ lbs. of oxygen, will evaporate 10 lbs. of water from 32°; hence 1 lb. of oxygen will convert 4 lbs. or $(27 \times 4 =)$ 108 cubic inches of water into vapour, which suffered to expand in vacuum, the work due to the force of expansion will be,

$$U_1 = aPK\int^{P} y^{-1} = a\,PK \log._{\epsilon} P \ldots\ldots\ldots\ldots\ldots (6):$$

whence if $K=1$, $a=108$ inches. And since the density of the steam at the instant it is being converted is 1700 times what it is at the atmospheric pressure, $P = 1700 \times 15 = 25500$ lbs., and therefore,

$$\begin{aligned} U_1 &= 108 \times 25500 \times \log._{\epsilon} 25500. \\ &= 2754000 \times 10.147 \\ &= 27944838 \text{ lbs. raised 1 inch} \\ &= 2328736 \text{ lbs. raised 1 foot.} \end{aligned}$$

And as a similar work would be done by the condensation of the steam, the whole duty for 1 lb. of oxygen applied to 4 lbs. of water is—4657472 lbs. raised 1 foot high.

But if 1 lb. of oxygen is consumed in each case, the power *of heat* employed is the same, and the loss when the force of the expansion and contraction of the water only is used, would appear to arise from the force necessary to overcome the attraction of the particles of the water, and other prejudicial resistances previous to its entering into a state of vapour. Taking, therefore, an unit of water = 1 lb., and putting ω = the prejudicial resistance, and attraction of the particles of water in an unit of water to work, previous to passing into vapour, we have this equation,

$$\begin{aligned} 30\omega + 80914 &= 4\omega + 4657472 \\ &= 176021 \text{ lbs. raised 1 foot.} \end{aligned}$$

These remarks are merely the ideas which occurred to me on reading "A. H.'s" paper, and very probably liable to many objections. I have recorded them, however, just as they occurred.

I am, Sir, yours, &c.,

W. DREDGE.

10, Norfolk-street, Strand, October 14, 1847.

NEW MODE OF MAKING ARTIFICIAL MAGNETS.

Sir,—As magnetism is now applied to many purposes of practical utility, as well as in many instructive and amusing experiments, and as artificial magnets can easily be made of greater power than loadstones, I presume it will be acceptable to many of your reades to know how artificial magnets may be made without any risk of failure.

Makers of magnets and compass-needles know that if the most careful and skilful workman be employed in preparing a number of magnets from the same steel bar, the magnetic power of the magnets, when compared with each other, will greatly vary; although every possible care may be taken in forging, tempering, and magnetising, in an uniform way. Experience in these matters convinced me that discrepancies in the magnetic powers of magnets of the same length, weight, and quality of steel, arise from the *tempering alone;* for if the metal be heated in a furnace, or coal fire, one part of the bar may be in contact with glowing coal, another part in flame, a third in heated air, a fourth in contact with coal in a state of ignition, &c.; consequently, the metal is not in all its parts raised to the *same* temperature, when suddenly removed from the fire and plunged into a cooling fluid. The relation between the degrees of heat in the heating and cooling mediums is absolutely unknown; magnets tempered in this uncertain way will possess different degress of hardness throughout their length, and their capacity for magnetism in all their particles will be unequal and uncertain.

[rea]soning in this way, it appeared to [me t]hat in order to make compass-[needle]s and steel magnets successfully, [we re]quire *specific heats* in the *warming* [as wel]l as in the *cooling* process of tem-[per]', in order to ensure the same de-[gree o]f hardness throughout the steel [—]that is to say, that the metal when [hot s]hould be a homogeneous mass, [and p]ossess a uniform capacity for the [recept]ion and retention of the magnetic [fluid].

[Met]alurgists know that lead melts at [a low] temperature, but if left on a good [fire] gets first a red, and then a white [heat,] that continuing to absorb caloric, [it ulti]mately *boils* at a uniform heat, [which] melts gold or silver, as is evident [in the] process of "cupelation." Now [here w]e have a *specific* heat at probably [...], and we have also a specific heat [of boi]ling water at 212°. It therefore [struck] me, that by heating my needles in [boiling] lead, and cooling them in boiling [water,] every particle of the steel would [be firs]t raised to, and then cooled down [to, the] same temperature and degree of [hardne]ss. The experiments have been [attended] with complete success; and more [power]ful magnets have been made in this [way th]an were ever made before, *without* [chance o]f *failure*.

[Mag]nets weighing 600 grains, and 6 [inches] in length, have held in suspen-[sion ...] times their own weight; and com-[pass-n]eedles have given by deflection 30°, [at twic]e their length, from a test-needle. [I find] that magnets tempered in this way [are not] liable to break, but possess with [their h]ardness a *toughness*, derived pro-[bably] from the boiling water. Their [power] of retaining the magnetic energy [has fo]r *four years* remained unimpaired, [thoug]h left without "keepers."

[To] manufacturers of magnets and [makers] of compass-needles, a knowledge [of thi]s mode of tempering steel, at a [uniform] temperature of the heating and [cooling] mediums, will enable them to [make a]rticles of a superior quality with-[out ris]k of failure, or needless expense; [and as] I have no other object in view [than th]e advancement of useful know-[ledge,] I now send you these remarks for [inser]tion.

[In h]eating the steel, the bars require [to be p]ressed under the surface of the [boiling] lead (as the steel would otherwise [float o]n its surface), and the magnet should be suddenly shifted from the lead to the boiling water, the instant it has acquired the temperature of the boiling lead; for to leave it longer in the lead would spoil the smooth surface of the steel, and render it as rough as if heated in a furnace or common fire.

I am, Sir, yours, &c.,
WILLIAM WALKER.
Q. H. Master.

Plymouth, Oct. 12, 1847.

HORÆ ALGEBRAICÆ. BY JAMES COCKLE, ESQ., M.A., BARRISTER-AT-LAW.

[Continued from page 332.]

VI. SURD EQUATIONS.

Let

$$x^2 + ax + b = \mathrm{F}(x) = 0 \;\ldots\ldots\; (1)$$

also let

$$(x + \tfrac{1}{2}a)^2 = \mathrm{X}; \; \tfrac{1}{4}a^2 - b = \mathrm{A};$$

$$\sqrt{\mathrm{X}} + \sqrt{\mathrm{A}} = f'(x); \text{ and } \sqrt{\mathrm{X}} - \sqrt{\mathrm{A}} = f''(x):$$

$$\text{then, } \mathrm{F}(x) = f'(x) \times f''(x) \;\ldots\ldots\; (2)$$

Again, let

$$\left.\begin{array}{l}\sqrt{\mathrm{X}+\beta} + \sqrt{\mathrm{A}+\beta} = f_1(x) \\ \text{and } \sqrt{\mathrm{X}+\beta} - \sqrt{\mathrm{A}+\beta} = f_2(x)\end{array}\right\} \ldots\ldots (\mathrm{J})$$

$$\text{then } (a),\ \mathrm{F}(x) = f_1(x) \times f_2(x) \;\ldots\ldots\; (3.)$$

Now, if the roots (supposed unequal,) of (1) be denoted by x_1 and x_2 respectively, we may make

$$f'(x_1) = 0; \text{ and } f''(x_2) = 0;$$

(conditions which exclude the corresponding ones

$$f'(x_2) = 0; \text{ and } f''(x_1) = 0;)$$

but it is not always possible by any values of x to make both

$$f_1(x) = 0; \text{ and } f_2(x) = 0;$$

although we can always satisfy *one* of these last equations (*b*).

Let y, a quantity which is not a root of (1), satisfy the relation

$$f_1(y) = 0 \;\ldots\ldots\ldots\ldots\ldots\; (4)$$

then,

$$f_2(y) = \pm \infty \;\ldots\ldots\ldots\ldots\; (5)$$

otherwise y would be a root of (1) contrary to supposition. Add those equations, then, by (J),

---

(*a*) Peacock, *Report of the third Meeting of the British Association* (Lond. 1834) page 235, note.

(*b*) Since the substitution of x_1, for x makes their product vanish, that substitution must satisfy *one* of those equations. The same thing occurs when x_2 is substituted. But x_1 and x_2 may both satisfy *one* of those equations; in which case the other has, in general,† *no* root.

† I shall take another opportunity of noticing cases like that of the equation (2) *supra*, p. 331, col. 2.

$$2\sqrt{Y+\beta} = \mp\infty \quad \ldots\ldots\ldots \quad (6)$$
if $Y = (y+\frac{1}{2}a)^2$.

From (6) we deduce (c)

$$y = \infty'$$

a value which does not satisfy (4), but which, on being substituted for y in that equation, gives $\infty' = 0$; and we should have obtained a similar result had we attempted to satisfy the equation $f_2(y) = 0$: hence

No quantity other than a root of $F(x) = 0$ *can satisfy either of the congeneric surd equations*

$$f_1(x) = 0, \text{ or } f_2(x) = 0.$$

In fact, since (4) and (5) are necessarily co-existent, the supposition that any quantity other than x_1 or x_2 can satisfy either of the above congeneric surd equations involves a numerical incongruity (d).

In the equation

$$x^2 - 21x + 54 \; [= F(x)] = 0$$

we have

$$X = x^2 - 21x + \frac{441}{4}; \; A = \frac{225}{4},$$

$$\text{take } \beta = 5x - \frac{185}{4},$$

$$\text{then } f_1(x) = x - 8 + \sqrt{5x+10}$$
$$f_2(x) = x - 8 - \sqrt{5x+10}.$$

If we equate to zero the last equation but one, we obtain an equation which I have already treated, [*supra*, p. 135 (e)].

Coston Rectory, October 7, 1847.

THE LAW OF ATMOSPHERIC RESISTANCE.

Extract of a letter from Professor Davies to the Editor, dated, Royal Military Academy, October 17, 1847.

"I mentioned to you some time ago the law of atmospheric resistance (the atmosphere being homogeneous within the limits of the problem) to the flight of a projectile, to which I had been led. My object, you will recollect, was to ascertain whether the same law, or anything analogous to it, had been propounded by any preceding inquirer; and I have freely enunciated it to several of my personal friends, with the same object in view. As I have hitherto heard of no one who has anticipated me, may I ask you to propose the question publicly through the medium of your widely-circulated Magazine? I do not wish at present to enter into any discussion of the law, or of the evidence on which it rests; much less to develope the considerations through which I was led to it: but simply to ascertain whether any one has trod the same steps before me, or arrived at the same conclusions; as, should such be the case, the work which contains it, may furnish materials that would lighten my labour in an intricate and somewhat laborious discussion.

"The law itself is this:

"If v be the velocity of a shot at any point in its path, and P be a constant depending on the physical condition of the atmosphere; then the resistance of the atmosphere to the progress of the shot will be

$$P\,(e^{fx} - 1):$$

and fx is such a function of x as to vanish with x, and which is under ordinary conditions but slightly different from x itself. In fact, I am led to think that the errors arising from so taking fx are so small as to be less than the probable errors of experiment, as this class of experiments has been hitherto made."

[We gladly accede to the wish of our esteemed correspondent: not, indeed, with any expectation that he will find his law anticipated, but because we are anxious that his claim to its first enunciation of the law should be placed beyond all future dispute. Its bearing upon the motions of military projectiles will be obvious to every one conversant with the subject: but its importance in the philosophy of partially-elastic fluids (that branch of natural science which is in the least satisfactory state possible) renders it of infinitely greater importance, than could attach to the solution of a merely military problem.

It will be remarked, too, that another extraordinary result has been obtained by "A.H," and is published in our present number: viz., that the law which Dulong and Petit obtained from a great number of carefully made experiments, has been deduced theoretically as the consequence of

(c) It is unnecessary here to do more than allude to the case of $\beta = \infty$.

(d) *Vide supra*, page 151, col. 2; and page 307, col. 2.

(e) Col. 2; equation (5).

ndamental law itself upon which all ies concerning heat are based. We ; but congratulate our readers on the first to whom such results are known; and we feel much gratified being selected as the organ through they were first published.—ED.M.M.]

IE USE OF ANTHRACITE (WELCH L) IN LOCOMOTIVES. BY PROFESSOR R. JOHNSON.

n the *Franklin Journal* for August 1847.)

e the attainment of so complete a s in using anthracite under the boilers tionary engines, and on board of all incipal river and sound steam vessels Atlantic coast, it has become a sub- much inquiry, to determine why so uccess has attended the efforts to in- e it into general use upon railroads. is trials on the Columbia Road, and on the Reading Road, have, it is stood, been attended with so little e of advantage, as to cause at present andonment of that fuel, and an ad- e to wood, as the only available mate- The cost of wood alone to the Reading ad, during the last year, is put down, late annual Report, at 202,061 dollars, s the total quantity of coal brought to t, over the road, was 1,188,258 gross we have, after deducting the wood ed for passenger and freight trains, an e of 191,569 dollars for the wood ed to haul that quantity of coal 94 and to take back the empty cars. It , that the whole of this coal did not tide-water, but the computation is upon the fact, stated in the Report of ompany, that the cost of wood, "per trip of 188 miles," to haul 360 tons l the above distance, and "back with cars," was 14·92 cords, costing 58·04 . It is estimated, by the President of ilroad Company, that the introduction hracite, instead of wood, would save mpany 125,000 dollars per annum. l it save half this sum, it is evident reat outlays, to effect the purpose, be warranted, and consequently, the heretofore made would be fully justi- Mr. Nichols, the engineer and general ntendent of the Reading Road, has or some time engaged in an effort to plish this object, by placing the engine iler on separate carriages, with a view enlargement of the fire surface of the Mr. N. has, in fact, used an ordi- ocomotive, to which he has attached, eparate truck, a boiler, 16 feet long, and 4½ feet wide, with a semi-cylindrical arch running the whole length. This is connected by jointed pipes with the engine. The blast is created by a fan, driven by a small engine. The escape steam is thrown into what was the original boiler of the locomotive engine, which is still retained, for the double purpose of serving as a *condenser*, and of making weight on the driving wheels. If this plan of condensation shall be found available, much time will be saved which is now consumed at water stations, as a large portion of the water will be constantly circulating.

So important to the Reading Railroad has this item of expenditure of *fuel* become, that, during the past year, efforts have been made by the company to manufacture an artificial fuel, with a basis of anthracite, as a substitute for wood. In this, they are understood to have so far succeeded, as to have made some trips with it. But still the desideratum is the use of anthracite alone.

Having several times, within seven or eight years, witnessed the exclusive use of anthracite, in all the locomotives on the Beaver Meadow and Hazleton Railroads, making round trips of thirty or forty miles, I have felt much interest in tracing the causes of ill success elsewhere.

From all the inquiries which I have been able to make, the following appear to be regarded as the chief impediments to the use of anthracite in locomotives:

1. The want of rapid ignition, and free, lively combustion.

2. The intense, concentrated, local heat which is said to destroy the grate-bars, to attack the rivets and laps of the fire-box, and even to cause blisters to rise in the plates of which it is composed; and, finally, to fuse the ashes into a troublesome clinker.

3. The sharp, angular particles of coal, projected by the violent, fitful blast of the escape steam, obliquely into the ends of *copper* tubes, cuts them away within a few inches of the fire end. In the upper range of tubes, it is the upper side which is chiefly attacked, and, as might be anticipated, in the lower ranges, the lower sides are most worn away. The effect of this cutting is usually limited to four or six inches of the length of the tubes.

4. The difficulty of fitting in iron tubes, so as to make perfect joints, and, at the same time, avoid irregularity in the form of the heads, and loosening one tube while another is fastened.

As the first of the above difficulties, the want of proper activity in the fire, has been completely overcome in our steam-boats, by the use of a steady fan-blast. it seems that an equivalent blast in the locomotive ought

to produce the same effect. The irregular, fitful current, generated by the waste steam, is not in all respects an equivalent to the blast of a fan, but when that blast is equalized, by projecting the escape steam, first into a receptacle of considerable magnitude, and then through a number of small pipes, equally distributed over the area of the chimney, the blast is so nearly equable, as to answer completely the purpose of sustaining the fire in brisk and uniform activity. This method of disposing of the escaping steam, originally invented by Mr. Gurney, and applied in common road engines, to prevent the frightening of horses, by the sudden, violent belching sound, was first introduced here by Mr. Hopkins Thomas, now of Beaver Meadow, while a workman in the employ of Messrs. Eastwick and Harrison. His object was a steady blast, not the mere avoidance of disagreeable noise.

The steam-box used to equalize the draught, is cylindrical, 12 inches in diameter, and 11 inches deep; two tubes, each 3 inches in diameter, flanched at the opposite ends to the steam-chests of the two cylinders of the locomotive, support the box in the interior of the dust-chamber, and convey the escape steam to its centre. A lid, ground to fit the top of the steam-box, has 18 jet-pipes, rising two or three inches from its upper surface, drawn in at the top to a diameter of half an inch. These are placed just beneath the base of the chimney, and their purpose is to distribute the escaping steam throughout the chimney, and, by limiting to some extent the rapidity of flow, to maintain within the box a pressure *approaching* to uniformity.

Messrs. Eastwick and Harrison founded, on a division of the receptacle into two parts, a patent, which they applied in some engines built by themselves. But as this evidently tended to make the action of the steam upon the air of the chimney, in a degree partial and fitful again, the Beaver Meadow and Hazleton Companies discarded this modification of Gurney's plan, and in all their engines, which have constantly used anthracite for the last eight or nine years, the draught is ample, the combustion regular, and the evaporation vigorous and well sustained. The fire is, of course, *kindled* with wood, and when this is well ignited, anthracite is added by little at a time, usually not more than a single shovelful, and in lumps, commonly not above six inches in diameter. If larger than this, they would remain too long in mass, dark and ineffectual; if small egg, or nut coal, alone were used, it would, it is alleged, by the jarring of the locomotive, spread over the whole fire at once, and check the evaporation. While under way, the bed of coal upon the grate is kept at a thickness of five, or at most, six inches. When fresh coal is added, care is taken that a single shovelful only is put on at once, and that this is thrown on the part which appears thinnest. Much experience in watching the indications of a manometre, while generating steam by anthracite, enables me fully to appreciate the importance of these practical precautions. In some of the attempts to use anthracite on the Reading Railroad, a bed of 18 inches thick is said to have been allowed to accumulate on the grate. In such cases, the whole engine is said to have become excessively overheated, and a flame to have passed out at the chimney. This is easily understood, when we consider that, in passing through so thick a mass of hot coal, the carbonic acid at first formed (CO_2) by taking up a second proportional of carbon, becomes $CO + CO$, or two proportionals of carbonic oxide. The atmospheric air to ignite this compound, gains admittance partly through the chinks of the fire-door, and the dust-box door, and is partly found near the chimney top, where the intermitting blast through a single jet-pipe, keeps the chimney alternately receiving and emitting air.

The second evil, that resulting from the highly concentrated heat, has been found much more serious than the preceding. Grate-bars were burnt out in a few weeks. Captain A. H. Vancleve, who had charge of the Beaver Meadow road, states, that at one period, wrought-iron bars were substituted for cast, but that it required two smiths' fires to be in constant employ, to make grate-bars for four locomotive engines. The secret of preventing this occurrence, was stated by a gentleman of Hazleton, to have been discovered by accident. A boulder, which had rolled from a slope upon the track of the railroad, tore off the ash-box of the first engine which passed. As the damage did not interfere with the running of the engine, and as it was not convenient for some days to return to the machine-shop, it was permitted to continue its trips for some days without an ash-box. The over heating and wasting of grate-bars were so manifestly obviated during the time, as to attract immediate attention. Ash-boxes were successively removed from other engines; and from the adoption of this alteration to the present time, the destruction of grate-bars has ceased to be a source of serious inconvenience. A set in the locomotive "Franklin," were put in in June, 1846, and were in use, and in good order, at the end of May, 1847.

It might be supposed that the wooden superstructure of the road, and particularly that of bridges, would be endangered by the

.nt falling of sparks. In the main, ' be said, that this evil at length cures for both roads and bridges, except the become covered with a stratum of ', and fine particles of coal, which ially defends all beneath from dan- ' igniting by particles of hot matter :he grate. Unlike particles of ignited ›al, these are, from their very weight, able to be easily raised and blown by the currents of air created by the which pass over them after they reach ad. Hence the only precaution which een found necessary, is to place two of iron, one on each *side* of the bot- f the fire-box, extending downwards nine inches, and sloping inwards, to e the falling cinders to the central ›f the track. At first a watch was ished at the bridges, but when the ay became covered with cinder, there ›und to be very little danger from this :. The Hazleton and Beaver Meadow have wooden rails, laid with flat iron where edge or T rails are used, the r would be manifestly less than in the ›f these roads, which have so long used icite without detriment.

: concentrated heat of anthracite fires, ılly affects injuriously only the laps vets of the fire-box, unless the iron of ıart of the boiler be of inferior quality. : the importance of selecting the very ›f iron for the fire-box, and the pro- utility as suggested by Captain Van- of subjecting it to a high temperature : using any plate for this purpose, in to detect blisters or imperfect weld- if such exist in the interior. The er of pieces used in the lower part of ·box ought to be the least possible, he horizontal laps ought not to have edges presented downwards to the ı of the rising flame. I see no practi- fficulty in the way of rolling sheets 18 ı wide, long enough to form the entire t of the lower part of a fire-box: that height there would be no danger this peculiar action of the fire. Nor know of any serious objection to ıg together the ends of such a sheet, ally if made three-eighths of an inch, re, in thickness, and thus forming a in which not a single joint or rivet l come in contact with the fire. All parts of the boiler would still be made ordinary manner.

: locomotive, Lehigh, commenced run- on the Hazleton road in 1838. In it was found necessary to renew a space ›ut 18 inches in the lower part of the ›x, and this is the only repair which ›art has undergone since the engine was put upon the road. I examined it in the latter part of May, 1847, and found the iron, to all appearance, sound and good, with no leaks at the rivets or elsewhere. Three or four of the upper rows of tubes in this engine have been in use since 1839, and the rest were renewed about two years ago.

To avoid the conversion of ashes into clinker, those anthracites should be selected which are free from slaty plies, and which contain the least of sulphuret of iron, or other fusible impurities. Should any inconvenience be found from clinker on a prolonged trip, it could easily be removed at a watering-station by means of a forked fire-hook adapted to that peculiar service. A small supply of wood may be carried, for re-kindling in case of unusual delays. But the experienced fireman will always be careful to clear coal and clinker from his grate before he attempts a renewal with wood.* Grates may be hinged, with a view to the prompt discharge of their contents; and with that facility, the re-kindling with wood may take place even without stopping the engine, especially if advantage be taken of a favourable grade of the road.

The third point of difficulty, that resulting from the cutting away of copper tubes, is fully obviated by the substitution of iron, with the farther advantage of economy in the first cost. But this brings us to the fourth and last difficulty—that of securing iron tubes to the heads of the boiler.

This has been attempted in several different ways. One consists in cutting a screw at each end of the tube, to enter corresponding threads cut in the heads of the boiler, and then riveting over the projecting edges of the tubes. That on which Mr. Baldwin has founded a patent, consists in brazing a short piece of copper tube to each end of the iron one, and then connecting the former with the head of the boiler, in the same manner as he puts in copper tubes. But that which seems the most simple, and which is quite effectual, as proved at Beaver Meadow and Hazleton, for a course of years, is the turning off of the iron tubes, on the outside, at each end, in the form of the frustrum of a cone, to the distance of seven-tenths of an inch, by which the thickness of the tube at the extremity is reduced about one-half. This conical part receives a ring of copper, cylindrical within, conical without, and about half an inch wide, which, after the iron tube has been inserted in its place, is driven on to its conical termination, filling the space between it and the edge of the aperture in the head of the

* This, and the succeeding precaution, are suggested by Captain Vancleve.

boiler. This copper ring, by its wedging effect, tightens the iron tube, forms a close joint, and allows the edge of the iron tube to be slightly opened out, and riveted, to form a very perfect juncture. The language used in describing the result of this mode of fitting in the tubes, was, that the "joints never leaked a drop." In rare instances, the welding of a tube, (made by the same process as gas tubes,) is found slightly defective; but this does not long put a stop to the use of the engine, for a very little labor suffices to tap a screw in each end, and plug up a single defective tube, till a convenient opportunity occurs for its removal. To clear dust of anthracite from the tubes, a species of screw auger, with a sharp edge, like that of a chisel, is occasionally employed.

The quantity of anthracite commonly used in a round trip of 30 miles, on the Hazleton Road, is from a ton to a ton and a half, hauling 35 to 40 cars, and conveying from 100 to 120 tons of coal. The grades on this road are heavy,—60, 80, and 140 feet per mile,—all in the direction of the trade. The severest labor is, consequently, encountered in taking back the empty trains. In two experiments, conducted by Capt. Vancleve, over the Beaver Meadow Road, reducing its grades by Pambour's formula to the condition of a level, he found that the 7-ton engine required 1¼ pounds of anthracite per ton, per mile, of *freight and cars* hauled, and the 13-ton engine took but one pound, for the same labor. The small engine was subject to slipping of its wheels, on the high grades, which, of course, impaired the efficiency of its fuel.

Those who are most familiar with this subject, attribute to the early persevering, and well-directed efforts of the Hon. Samuel D. Ingham, formerly president of the Beaver Meadow Railroad Company, much of the credit of urging on to final success, the experiments which have proved so important to the interests of that coal region.

ADCOCK'S SPRAY-PUMP.

Sir,—Mr. Adcock having declined to put your readers in possession of better *data* than those which I sent you on the 8th ult.; I will now show, by other *data* and calculations, the correctness of what I first stated, respecting the power employed and work done by the patent spray-pump at Llanhithell, Monmouthshire.

Last week, I again paid a visit to Llanhithell, in order to see what the spray-pump was doing, after being at work above three months. But on arriving there I found it was stopping, owing to the leaky condition of the boilers. Data however I obtained, and with your permission I shall lay the same before your readers.

Before giving the work done, I may as well state that the depth of the pit is about 80 feet. A common lifting-pump lifts the water from the bottom of the pit to a height of about 60 feet, and there delivers it into a cistern for the spray-pump to blow it up the remaining 20 feet or thereabouts. It is but fair I should state that the spray-pump blows it up some 26 feet—that is, 6 feet above the surface. But as this would not be necessary with an ordinary pump, I have neglected the excess altogether in the following calculations:

The diameter of the blowing-cylinder is 50 inches, (not 48½, as I stated by mistake in my first letter.) Length of a double stroke, 12 feet. The blast-gauge is removed—for what purpose I shall leave others to guess; but the valve on the air-regulator was loaded with a pressure of 5lbs on the square inch. Taking 4½lbs. as the working pressure, we have 106,000 lbs. lifted 1 foot high as the power expended for each double stroke of the blowing-piston. The working beam of the blowing-cylinder is connected by a short link with the beam belonging to the lifting-pump, which is 21 inches diameter, and 3 feet 11 inches stroke. Now if we suppose that the lifting-pump leaked none at all, and that the spray-pump delivered all that it received, (which I was assured it did not) it will not amount to 12,000 lbs. lifted 1 foot high, against an expenditure of 106,000 lbs. the same height—fully corroborating what I first stated.

In order to show your readers what advantages Mr. Adcock claims for his patent spray-pump, and how far they have been realized in practice, I shall make the following extracts from his pamphlet, beginning with page 4:

"1. I employ neither pumps nor pump-rods.

"2. There is but *one* lift, whatever the depth of the mine.

"3. As there is but one lift, I employ *neither clacks nor valves.*"

At Llanhithell there is as already stated *two* lifts with *one valve* in the spray, and two in the common pump, and no fewer than thirteen large le-

clacks or valves on the blowing-
:r ! !

The water pipes or pump-trees are nd put down at little cost; they are of sheet-zinc, beat into shape, d, and soldered to one another; flanges and screw-bolts are dispensed

:re are 8 screw-pins in each pipe, .e pipes are in every respect the as cast-iron flange-pipes would be kness excepted:

Being made of sheet-zinc, the pipes, rse, are of light weight; and there- quire but few, and very slight, horse- o support them."

. Adcock lays great stress on the being of sheet-zinc. If *ever* he a spray-pump in a deep pit, the tone which leaves the side of the d strikes his pipes will show pretty y which is the most suitable for -work—zinc or iron:

Wear and tear, comparatively speak- ere is none."

there no wear and tear about a ng-piston, piston-rod, stuffing-box, :r clacks, parallel motion, spur- ıg, &c.? Contrast these with the and tear of a solitary stuffing-box, ouple of clacks.

. The steam-engine that I employ is :-acting, and not single-acting. It is ch less size, and of much less power, here is not occasion to erect it, as in work, at the pit's mouth. On the ry, one engine may, with facility, be to work two or three pits at consider- istances apart."

louble-acting engine, such as Mr. ck employs, requires about four as much fuel as a single-acting ing-engine of equal power. The oying an engine of "much less r"! ! Comment is useless; and as e facility of working two or three it is as common to one plan as to ıer:

. I economise largely in the consump- of fuel; and in tallow-packing, and athering of buckets and clacks; also our."

is is totally at variance with facts, ur readers may see from what I stated:

. The ventilation of a mine is pro- free of cost."

ıere are but two ways to produce this ventilation. Either a large pipe must be carried from the blowing-cylinder to the bottom of the pit, or the top of the latter must be domed over and rendered useless for any other purpose. Neither plan could be adopted free of cost:

"10. In taking up the present plant of a mine, to put down the new, generally speaking, the sale of the old materials will more than repay the cost of the patented apparatus."

The patented apparatus at Llanhithell has cost *ten times* as much as the common lifting-pump; and if we were to take it depth for depth, it has cost at least *thirty times* as much as the latter!!

I shall make one other extract, as a specimen of what Mr. Adcock is capable of saying and doing. At page 7, he says:

"11. I had an apparatus made, on the patent principle, to raise, agreeably to an order which I had received, 40 gallons of water in a minute, 42 feet in height. It was erected at the well-known works of Messrs. Milne, Travis, and Milne, at Shaw, near Manchester. The fan which gave motion to the air was only 3 feet diameter, and a foot wide, and it made about 900 revolutions in a minute. Instead of raising 40 gallons, 42 feet in height per minute, it raised at the rate of 130 gallons of water per minute, 120 feet in height. This effect, so much greater than it ought to have been for the *power expended*, caused me for some time much anxiety of mind. It seems to arise from a law of nature, which is but *little known or understood by practical men.* I cannot however enter upon the details here."

Three times the quantity to three times the height; or, in other words, the work done was *nine times* that due to the power expended!! If this is not very much akin to PERPETUAL MOTION, Cassell Morlais labours under a very great mistake indeed.

From the manner in which Mr. Adcock replies to my letter, I am under the necessity of extracting the following from his pamphlet, (page 18,) where he says:

"12. It cannot therefore be too forcibly impressed on the minds of the reflective, that I am not only *willing*, but am *desirous*, to receive, and to *answer*, any questions where doubts may arise, as to the practical value and efficiency of the invention."

I shall leave it to you, Mr. Editor, to

say if Mr. Adcock's letter, does or does not belie this statement of his *.

I am, Sir, yours, &c.
CASSELL MORLAIS.

"RAINING UPWARDS."—ADCOCK'S SPRAY-PUMP.

Sir,—Having recently had an opportunity of witnessing the effect of wind in the conversion of a small stream of water falling over a cliff into spray, I became satisfied that the process might be fairly enough termed "*raining upwards.*" This expression has been, I believe, occasionally applied to Adcock's patent spray-pump; and whatever may be the commercial results of raising water in a stream of air as measured by duty, or pounds of water raised 1 foot high by a bushel of coals, the fact itself is curious, and suggests some interesting speculations as to the quantity of air in proportion to the water—the best velocity of the air—and the size of the particles of water best adapted for suspension in the air.

In the natural operation the water raised above the cliff by the wind, was separated into particles of various sizes: the larger were blown a few feet up the gully down which the small stream flowed, and fell as rain; but the smaller, after passing a certain space, became invisible. The wind was dry and warm, and possibly possessed heat enough for the conversion of the water into vapour, or steam of a low temperature. The conditions seemed favourable for an ocular demonstration of the process of lifting water as spray by the action of a current of air, whose velocity just at the edge of the cliff might have been from 15 to 20 miles per hour, but at a small distance probably did not exceed 10 or 12 miles an hour,—a lower velocity, as I remarked at the time, than I should have anticipated as capable of raising water as spray. I do not, however, speak with any great confidence respecting the velocity of the wind—and it must be confessed that my enthusiasm in the cause of science was not sufficient to induce me to enter the shower of rain with a view of attempting a closer approximation. It was quite obvious, however, that the current of wind was stronger than at the side of the gully where I stood.

In regard to the merits of the spray-pump, Mr. Adcock's violence of language simply leaves your anonymous correspondent's figures and data untouched—though they might not be deemed of much value against a specific contradictory statement of the facts or data supplied by parties avowedly interested in the result of their statements. The following numerical results can be readily changed, whenever Mr. Adcock or his friends deem it proper to supply more authentic data:

The content of the blast-cylinder is just 77 cubic feet, and 40 cylinders' full per minute are used to raise $\frac{840}{8} = 105$ cubic feet of water per minute. Hence, $77 \times 60 = 3080$ cubic feet of air; and consequently $\frac{3080}{105} = 30$ cubic feet of air to 1 of water. Allowing for deficiency in the delivery of air, possibly 25 of air to 1 of water would be a closer approximation.

Now the fact of the removal of so large a quantity of air, if taken from the lower levels, would be an object of great importance to many mines. In regard to the water-load, the additional air-load in pounds would be about 3 per cent. only.

The comparative amount of capital expended on the patent spray, and on the common pumps, is another part of the subject, and the balance of these several considerations must be struck by the mine-owner.

Difficulties inevitably arise in the introduction of any alteration; yet improvers are apt to require or ask for proofs that their schemes are defective and assume the contrary, or success—in case of non-compliance—quite forgetting that the burden of proof of their assertions rests on them.

Feeling some interest in Adcock's spray-pump, in consequence of a previous opinion that the whole affair was an in-

* We stated two weeks ago that we had reason to believe there was a wicked conspiracy on foot to depreciate Mr. Adcock's invention by the circulation of *wilfully* erroneous statements respecting it, and have declined inserting some anonymous, or rather pseudonymous communications on the subject, which appeared to us to have the stamp of this conspiracy upon them. It is due, however, to "Cassell Morlais" to say that our remarks had no allusion to him. We see nothing in his letters which at all exceeds the limits of fair discussion, or absolves Mr. Adcock from his own voluntary pledge to the public, "to answer any questions where doubts may arise as to the practical value and efficiency of the invention." We will be no parties to any attempt to deal unfairly with Mr. Adcock's invention; but equal justice requires that we should not refuse the aid of our columns to prevent Mr. Adcock from dealing unfairly by the public.—ED. M. M.

ı dream, but being convinced at : that this plan of raising water is the limits of possibility, I am de- of knowing its relative value, and ıditions under which it may be ble in practice.

Adcock may rest assured that his explosion of temper can only injure his own cause; and I hold that every person has a right to use the data supplied by your correspondent until more authentic statements are submitted to the public.

I am, Sir, yours, &c.,

October 9, 1847. S. S.

WEEKLY LIST OF NEW ENGLISH PATENTS GRANTED.

ıd Tattersall, of Newmarket, land-sur- ır improvements in making communica- m one part of a railway train to another. six months.

Ridgway, of Cauldon-place, Stafford, for mprovements in the manufacture of paste nd other similar articles in china and are, or other plastic materials. Oct. 21; hs.

Forster, of Streatham, Surrey, manu- for improvements in combining gutta ith certain materials, and in the applica- eof to waterproofing fabrics, and in mould- ous articles therefrom, in finishing the sur- ticles made from gutta percha, or gutta ombined with other materials, and in gutta percha. Oct. 21; six months.

Richardson Banks, of Great George-street, ıster, architect, for a new method of arti- uring and preserving the berries of coffee ng-apparatus. Oct. 21; six months.

Neville, of Walworth, Surrey, civil engi- certain improvements for conveying goods and passengers on railroads, parts of such improvements being applicable for working or driving other descriptions of machinery. Oct. 21; six months.

Brooke Smith, of Birmingham, manufacturer, and Richard Ford Burges, of the same place, manufacturer, for a certain improvement, or certain improvements in apparatus for filtering. Oct. 21; six months.

Charlton Henry Sloman, of St. Martin's-lane, Middlesex, for certain improvements in apparatus used for ironing. Oct. 21; six months.

William Gostuyck Gard, of Calstock, Cornwall, engineer, for certain improvements in machinery or implements for boring and sinking. Oct. 21; six months.

Richard Shaw, of Golds-green, West Bromwich, Stafford, for improvements in the manufacture of wrought iron railway bars and railway chairs. Oct. 21; six months.

Patrick Playfair, merchant, and Lawrence Hill, jun., civil engineer, for improvements in the manufacture of sugars. Oct. 21; six months.

OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED UNDER 6 & 7 VIC. CAP. 65.

No. in the Register.	Proprietors' Names.	Address.	Subject of Design.
1231	Isaac Dodds	Glasgow, civil engineer	Rail straightening-machine.
1232	Thomas Key	Charing-cross	Improved clarionet.
1233	Collard and Collard	Cheapside	Square pianoforte.
1234	Charles Rowley	Birmingham	Cigar-lighter and ash-pan,
1235	Charles & James Yorke,	Cambridge	Revolving easy chair.

Mechanics' Magazine.

STAMPED EDITION.

TO meet the numerous demands for the earliest possible Copies of this Journal, a Stamped Edition to go by post, price 4d., will be commenced on the 6th November next. It will be published every Friday, at 4 o'clock, p.m., precisely, and contain the New Patents sealed, and Articles of Utility registered during each week, up to the time of going to press. Subscribers are requested to give their orders as early as possible. Subscriptions to be paid in advance. Per annum 17*s.* 4*d.*, half-yearly 8*s.* 8*d.*, quarterly 4*s.* 4*d.*

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CONTENTS OF THIS NUMBER.

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Mechanics' Magazine,

SEUM, REGISTER, JOURNAL, AND GAZETTE.

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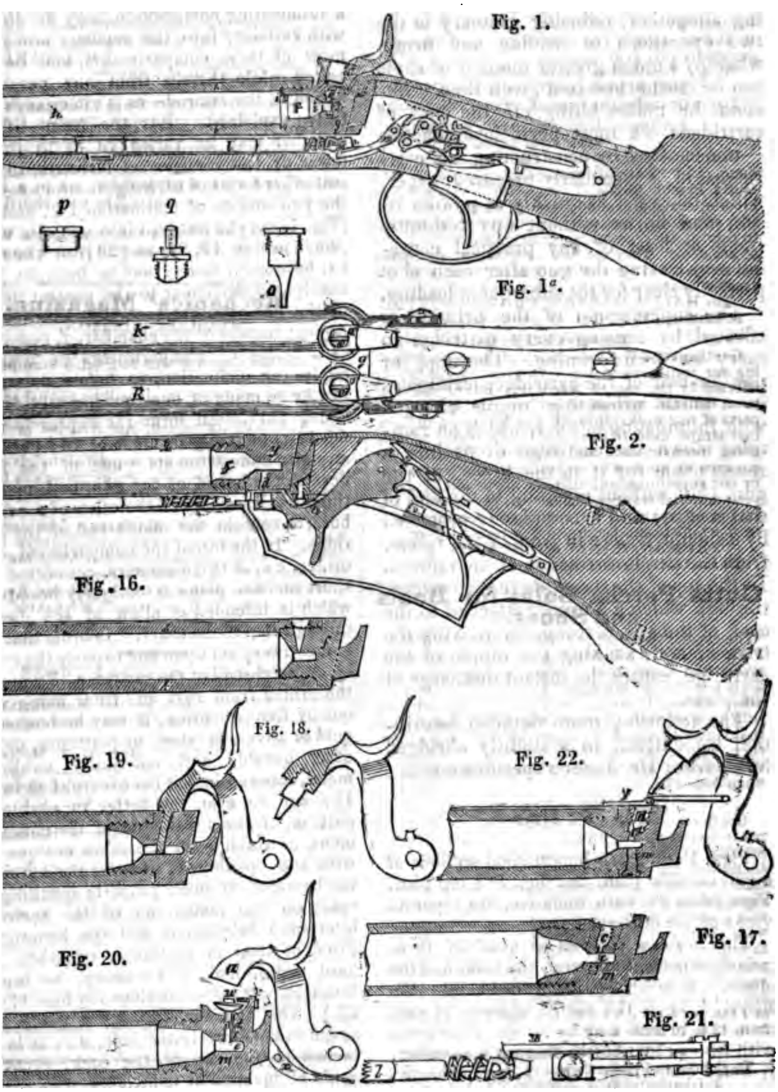
Edited by J. C. Robertson, 166 Fleet-street.

DR. JAGER'S PATENT IMPROVEMENTS IN FIRE-ARMS AND CARTRIDGES.



DR. JAGER'S PATENT IMPROVEMENTS IN FIRE-ARMS AND CARTRIDGES.

[Patent dated April 15, 1847 (in name of Mr. John Mollett, on behalf of Inventor.) Specification enrolled October 15, 1847.]

There are two leading features in Dr. Jager's improvements which distinguish his system of projectiles most favourably from all others yet brought before the public: *First*, he dispenses both with loose priming and percussion caps — does away in fact with priming altogether, reducing gunnery to the two operations of loading and firing, whereby a much greater number of shots can be discharged in a given time. *Second*, he makes biting off the ends of cartridges — a most pernicious practice —unnecessary by constructing his cartridges of a peculiarly-prepared paper, which takes fire as quickly as powder itself, and burns without any residuum (none at least of any practical consequence) leaving the gun after each shot perfectly clear for the subsequent loading.

The supercession of the priming is effected by causing every cartridge to carry its own priming. The top, or powder-end of the cartridge, terminates in a small projecting nipple charged with fulminating powder, which on ramming down the cartridge drops into a recess made for it in the breech of the gun, (but without reaching to the end of that recess,) and is completely protected by a shoulder-piece in front of the recess, from the percussive action of the ramrod. In the top of the recess there is an orifice, through which a hammer attached to the cock of the gun descends on drawing the trigger, and, striking the nipple of the cartridge, causes the instant discharge of the piece.

The following more detailed description we extract, in a slightly abridged form, from Dr. Jager's specification:

The Fire Arms.

Figs. 1 and 2 are longitudinal sections of a gun on this plan, and fig. 1^a a top plan. Figs. 16 to 22, both inclusive, are separate views of the different parts.

The fire-arm consists as usual of three principal parts, the barrel, the lock, and the stock. A breech, *g*, is screwed into the barrel, *k*, or if the barrel is made of cast iron, the breech may be in the same piece with it. In this breech there is a chamber, *f*, bored out, which, in fig. 1, is represented as consisting of five main diameters, 1, 2, 3, 4, 5, and of gradually diminishing diameter in each of the intermediate spaces, or, in other words, of four cone-like compartments of successively diminishing angles of inclination. It is made of this form, in order that the small end of the cartridge which is charged, as before mentioned, with a fulminating composition, may be directed with certainty into the smallest and innermost of these compartments, and be protected while therein from any percussive action of the ramrod—as is afterwards more fully explained. But the form of this chamber may be varied, so as to present fewer or lesser angles of inclination, or to suit other forms of cartridges;—for example, the two angles of inclination 1 2, and 2 3. (Fig. 1) may be resolved into one, (as exemplified in figs. 19, 20, and 22;) or the sides, *i i*, between 3 and 4, may be brought more nearly perpendicular to the central line, *h*, of the fire-arm, (as exemplified in fig. 16.) Again; instead of the chamber, *f*, consisting of a series of compartments of different angles of inclination, as before described, it may be made of one continuously-diminishing curvilineal form (as represented in fig. 17;) or it may be made of two perfectly straight compartments,—one of the same bore as the barrel of the gun, and in continuation thereof; and the other of a smaller bore, to contain the match-end of the cartridge. In the top of the compartment, *e*, an orifice, *c d*, of two diameters, connected by a short inclined plane is obliquely bored out, which is intended to allow of the descent through it of the hammer, *o*, in order that that hammer may act upon and explode the smaller, or match-end of the cartridge. To protect the orifice from rust and from being worn out by frequent firing, it may be bushed by gold or silver, or steel, or platinum, or any other durable and not easily oxidizible metal, screwed into it (as exemplified in fig. 17;) and so, also, the better to enable the part, *m*, of the under side of the compartment, *e*, which is in the same oblique line with the opening, *c*, to resist the blows of the hammer, or more properly speaking, to react on the match-end of the cartridge interposed between it and the hammer, a piece of steel or platinum, or other like hard metal, may, if necessary, be tapped into that part (*m*)—(as shown in figs. 17 and 22.) The hammer, (fig. 0,) is made of a shape to enter freely the hole, *d c*; it is attached to the end of the cock, *a*, at an angle of inclination coinciding with that of the hole, and it is of such length as to hit

Fig. 3.

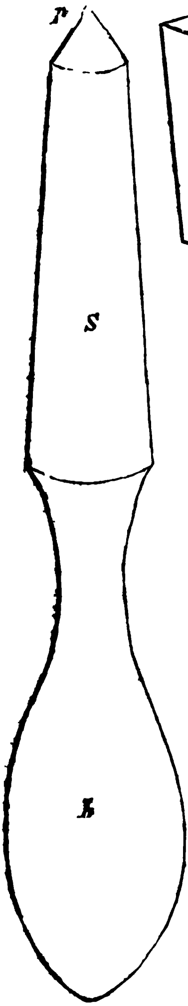


Fig. 4.

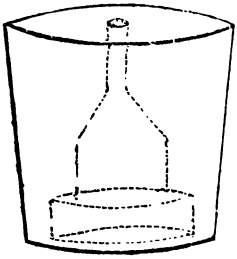


Fig. 7.

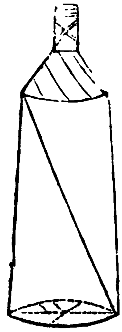


Fig. 10.

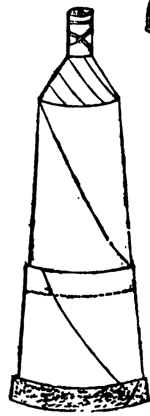


Fig. 13.

Fig. 12

Fig. 14.

Fig. 6.

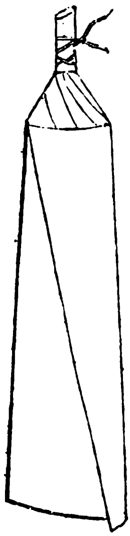


Fig. 11.

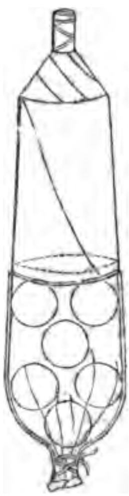


Fig. 9.

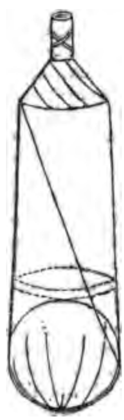


Fig. 15.

Fig. 5.

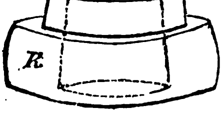
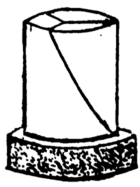


Fig. 8.



against the point, *m*, on the drawing of the trigger. It may be made in one piece with the cock; but I prefer making it in a separate piece to screw into the cock in the mode represented in fig. 1 and fig. 1*a*; or in that represented in fig. 18, in which case the shoulder of the cock should be made of a square or angular form, as shown. To protect the hammer-opening, *d c*, from wet, it may have a to-and-fro sliding cover, *y*, fitted to it (*see* fig. 22), and so connected by levers with the cock that when the trigger is drawn the cock shall push the cover forwards clear of the opening in time to allow of the descent of the hammer on the match-end of the cartridge. On pulling back the cock (after discharge) the cover is of course restored to its original position. Should it be thought desirable to keep the hammer-opening during the instant of discharge, still more completely closed than is provided for by the construction before described, both the hammer and the hammer-opening may be made of the more close fitting forms represented in fig. 19, and the former made of the same piece with the cock.

To keep the ramrod, *l*, fast in its place at all times, except when it is required for use, a balance scroll lever, *n*, with hooked termination, is attached to the side of the lock in such a position that as long as the cock is in a state of inaction, the hooked termination of the lever interlocks with the screw-end of the ramrod and prevents it from being withdrawn, while as soon as the hammer is drawn back to half-cock the lever is turned on its centre, and the ramrod released to enable it to be used in loading the gun; and on the ramrod being returned to its place after loading, then the drawing back of the hammer to full-cock reverses the position of the lever, and causes it to lay fast hold again of the ramrod. The mode of connecting the cock with the ramrod may be varied; as, for example, the hooked lever, *n*, might be made to act downwards instead of upwards, or instead of the scroll lever, *n*, a straight spring catch, *z*, might be substituted, (such as represented in fig. 21;) but the inventor considers the mode of connection first described as being the best mode of carrying out this part of his invention, which has for its distinguishing feature the locking and unlocking of the ramrod by means of the cock, so that it shall never be at liberty till it is required for use.

In the arrangements before described the hammer is shown as acting in an oblique direction on the match-end of the cartridge, and the hammer-opening in the breech as having necessarily a corresponding inclination; but both may be made of any greater degree of inclination thought desirable, or indeed perfectly vertical, (as shown in fig. 16.) Again; instead of making the hammer opening through the breech-piece, *f*, only the breech-piece may be screwed farther into the barrel and the hammer-opening made through both the barrel and breech (as also exemplified in fig. 16.)

Fig. 2, represents a gun constructed on the same plan as the preceding, but with the parts placed in an inverted position; that is to say, with the lock and the parts connected with and dependent upon it, turned upside down, so that the hammer shall act from beneath, and the sight from the butt-end to the muzzle be left clear and uninterrupted, save only by a sight piece as usual; or instead of the lock being so placed as to act either downwards or upwards, it may by very obvious modifications be adapted to act at either side of the gun.

A modification of a different character is shown in fig. 20. In this case, the hammer, *o*, is entirely separated from the cock, *s*, and rests permanently (while out of action) in the opening, *d c*, and on the point, *m*, of the under side of the compartment, *e*, of the gun, but is provided with a shoulder, *w*, against which one end of a balance scroll lever, *x*, attached to the side of the lock abuts, while the other end is acted upon by the hinder end of the cock; so that, on the cock being drawn half back it depresses one end of the lever, *x*, and throws up the other end sufficiently to allow of the loading going on, and of the match end of the cartridge being introduced into the innermost compartment, *e*, (to the limited extent before directed,) while on drawing back the cock to full cock and drawing the trigger, the cock descends on the hammer and causes it to fire the gun.

As it may occasionally be desirable to convert the fire-arm of each of the varieties described into a common percussion gun—as for instance, on a failure in the supply of cartridges of the construction of those described—the inventor proposes to effect this by removing the hammer, *o*, and inserting in its place a flat hammer, (such as represented in fig. *p*,) and then screwing into the opening, *c d*, a touch-hole of the form shown in figure *q*, to which percussion caps may be applied in the usual way.

The Cartridge.

Paper, or cloth suitable for the cartridge, is prepared in the following manner: A quantity of dextrine, or British gum, or other substance possessing the same or similar properties, is dissolved in concentrated or fuming nitric acid to the point of satu-

ı, and from this mixture a white sub
s (called by some xyloidine) is ob-
l by precipitation in water, and after-
ɪ well dried. Or, instead of preparing
hite substance for the purpose, it may be
›yed ready made, whether manufactured
e above or by any other process. One
by weight, of this white substance is
dissolved in about 100 parts, also by
ıt, of concentrated, or fuming nitric
more or less, according to the degree
nbustibility and firmness desired to be
to the paper or cloth; after which,
50 to 100 parts, by weight, of concen-
sulphuric acid are added. In this acid
on, the paper or cloth is first im-
›d; it is then wiped free from any su-
ous acid, and next steeped in running
for two or three hours, or laid in a
-bath for a day or two, renewing the
as often as it becomes foul; it is
that passed between heated rollers, or
ed between heated sheets of metal,
:by it is smoothened and consolidated.
ld it be desired to neutralize the acid
arther, this is done by dipping it in an
ne solution of more or less strength.
flammable material for cartridges, but
inferior quality to the preceding, may be
›repared by simply immersing paper or
in nitric and sulphuric acids, and af-
rds washing as before directed.
form this prepared paper or cloth into
:ridge, a piece of it is rolled round a
of wood, metal, or other suitable ma-
, (such as represented in fig. 3;) that is,
the body, S, of the shape only, leaving
ınd, *h*, free. The piece of paper or
must be of such length as to extend a
way beyond the extreme point, *p*; it
n made temporarily fast in this posi-
ɪy slipping over it a ring, R, (shown
ıtely in fig. 5;) the portion of the
or cloth above the point, *p*, is then
gnated or coated with some suitable
ıating composition, either by dipping
ıne in the composition in a fluid state,
doing it over on the inside with the
osition in a moist state by means of a
or spatula—care being taken in both
not to apply the composition lower
than the point, *p*. The inventor prefers
ɪying a composition formed of two parts
minating quicksilver and one part of
›wder; but he does not confine himself
use of any particular composition. The
ɪn of the paper or cloth so prepared
n twisted round and tied with thread,
ı has been prepared in the same way as
aper or cloth itself, in which state the
dge, so far as now formed, assumes the
rance represented in fig. 6. Or, in-
of applying the composition to the end of the piece of paper or cloth of which the body of the cartridge is composed, a small roll or pellet of paper or cloth may be charged with the composition and inserted in the twisted end of the cartridge, and afterwards made fast in its place by tying as before; or a small capsule, (such as shown in fig. 12,) made of paper or cloth prepared as aforesaid, may be charged with the fulminating composition, and slipped over the small end of the cartridge, and then tied. The better to enable the composition to retain its hold of the paper or cloth, it may be coated with a solution of dexine, or a solution of any readily inflammable gum or resin, as shellac or gutta percha. The upper end of the shape, S, with the paper or cloth enveloping it, is next pressed, by means of the handle *h*, into a mould of the form shown in fig. 4, (in which the full lines represent the exterior of the mould, and the dotted lines the interior,) and turned round and round therein, till all the part of the intended cartridge above the ring, R, has been smoothed and fashioned into the exact form of the mould. By comparing fig. 4 with fig. 1, it will be seen that the form of this mould exactly corresponds with the three innermost compartments (2 3, 3 4, and 4 5,) of the chamber, *f*, of the gun; and according as the form of that chamber may happen to be varied, so also must the form of the mould. Care must in every case be taken that the match-end of the cartridge shall not reach to the end of the innermost compartment, 4 5, but stop a little way short thereof; it need not, indeed, reach farther than just beyond the hammer-opening, *c*. Should, therefore, this match-end happen, from the miscalculation or carelessness of workmen, to exceed that length, it must at this stage of the process be clipped down to the proper standard. The ring, R, is then slipped off, and the bottom end of the cartridge filled with gunpowder, after which the ends of the paper or cloth are joined together, and closed up by paste, or any other suitable cement, (as represented in fig. 7.) In using this cartridge, the shot may be contained in a separate cartridge, made of paper or cloth prepared as aforesaid, or of common paper, and of the form shown in fig. 8: or the shot or ball may be added to the original cartridge, (as represented in figs. 9, 10, and 11.)

When the match-end of the cartridge is made, as before directed, of such length as to protrude into the innermost compartment *e* (4 5) of the breech of the gun to the limited extent only before directed, and when the sides of the breech in front of that compartment are either at right angles to it, or so inclined as to present an abutment for

the shoulders of the cartridge to bear against, it follows, that, by no pushing of the ramrod in loading, however forcible or prolonged, can the match-end be so concussed as to take fire: for no pressure can force the metal end further in than it was at first, and the gunpowder in the cartridge serves, as if it were so much sand, to protect it from the percussive action of the ramrod. Cartridges made of paper or cloth prepared in the same way as that employed in the construction of those before described, but without the small match end, may be employed with advantage in percussion guns of the ordinary kind, or in guns of the improved description just described when altered to the ordinary percussion form. The explosion of the common percussion cap will set fire to the paper of such cartridges as readily as to the gunpowder itself.

It may happen with this as with other fire-arms that it may miss fire. In that case, instead of withdrawing the cartridge, (though this may be done with perfect safety if preferred,) the inventor takes a small match or capsule prepared in the same way as the cartridge-paper before described, and of any of the forms represented in figs. 12, 13, 14, or 15, and either slips it over the end of the hammer, or inserts it in the hammer-opening, after which he again cocks the gun and draws the trigger, when the descent of the hammer rarely fails to explode the capsule and discharge the gun.

Instead of charging the cartridges with gunpowder, as before directed, they may be filled with gun-cotton, or any other suitable explosive compound; but Dr. Jager prefers gunpowder, as being freest from danger of accidents, and abundantly effective.

The improvements before described, both as regards fire-arms and cartridges, are stated to be of universal applicability, whatever may be the dimensions of the arm or the particular purpose to which it is applied.

ON ELIMINATION IN LINEAR EQUATIONS. BY PROFESSOR YOUNG, BELFAST.

Methods for the elimination of the unknown quantities from a group of simultaneous equations of the first degree are given in most books of algebra. These methods are usually presented under a twofold aspect, in order to meet the wants of the computer, as well in the case in which the coefficients of the unknown quantities are arbitrary symbols, as in that in which these coefficients represent definite and prescribed numbers. Either method will indeed answer both purposes; but as in dealing with known coefficients, we may often avail ourselves of certain numerical relations in the way of arithmetical simplification of the work, it is better to employ a process in the course of which we can take advantage of these facilitating circumstances, than to imitate the steps of the general investigation—or even to apply at once the final formulæ to which this investigation leads.

There are certain inquiries, however, beyond the limits of ordinary algebra, in which the general formulæ adverted to perform an important part:—inquiries in which the object is, not to determine numerical values, but to establish geometrical properties and mechanical relations; though it is seldom, even for such purposes as these, that formulæ for more than *three* unknown quantities are ever required. Accordingly we find that general expressions for a greater number of unknowns do not occur in algebraical writings; their length and complication, as well as their comparative inutility, seeming to justify their exclusion. Even as respects the forms for three, the general investigation is sufficiently troublesome to render a permanent record of those forms, for the purpose of reference, acceptable to the algebraist; though every investigator is desirous of being as independent of this kind of aid as possible, more especially in cases such as those we here refer to, where, from the prevailing notation, typographical errors are liable to occur from omission of accents.

On this account I have thought it would perhaps be acceptable—at least to the student—to possess a short and easily-remembered method of recovering these formulæ at any time without reference to a book; and it is for the purpose of suggesting such a method that I submit the present communication to the readers of the *Mechanics' Magazine*.

The equations to be considered, expressed in the usual notation, are these: viz.,

$$ax + by + cz + d = 0$$
$$a'x + b'y + c'z + d' = 0$$
$$a''x + b''y + c''z + d'' = 0,$$

and to obtain from them the general expression for either of the unknown quantities, the process I would recommend is this:—

1. Let a line be drawn under those terms of the last equation which involve the other two unknowns.

2. Multiply crosswise the coefficients above this line of the first and second equations,

separating the resulting products with the minus sign; do the same with the second and third equations; then with the first and third, taking care here however to *transpose the results.*

This is all that need be made mere matter of memory; the three binomial expressions thus obtained will furnish the numerator of the sought value when each binomial has connected with it, as a factor, the final term (d, d' or d'') of that equation which is not used in forming the binomial. The denominator will consist of the same binomials; but here the factor belonging to each will be that coefficient in the same unused equation, which is prefixed to the unknown whose value is sought.

The insertion of the correct factors, whether in numerator or denominator, can require no effort of memory, for a mere inspection will show which of the three factors, in either case, has claim to be introduced to the exclusion of the others.

Guided by these precepts, the elemination of z will be effected in the following manner, where only the terms involving the other unknowns, x and y, are written down; since the coefficients of these alone enter into the formation of the binomials:

$$\begin{array}{c} ax+by \\ a'x+b'y \\ a''x+b''y \\ \hline a'b-b'a \\ a''b'-b''a' \\ b''a-a''b \end{array}$$

These are the binomials which enter alike into numerator and denominator in the formula for z. For the numerator, they are to be multiplied respectively by d'', d, and d'; and for the denominator, by c'', c, and c'. As above remarked, it is plain, from inspection, that this is the proper order of these factors; for if any other order were for a moment imagined, mere symmetry of position would forbid the arrangement; we could not, for instance, in forming the numerator, connect the binomial $a'b-b'a$ with d or d', seeing that each has *equal* claim to be selected: a circumstance which necessitates the exclusion of both; and, on like grounds, in forming the denominator, this same binomial cannot take for factor either c or c'. The value of z is thus:

$$z=\frac{(a'b-b'a)d''+(a''b'-b''a')\,d+(b''a-a''b)\,d'}{(a'b-b'a)\,c''+(a''b'-b''a')\,c+(b''a-a''b)\,c'}$$

Proceeding in like manner for y and x,

$$\begin{array}{ccc} ax+cz & \qquad & by+cz \\ a'x+c'z & & b'y+c'z \\ a''x+c''z & & b''y+c''z \\ \hline a'c-c'a & & b'c-c'b \\ a''c'-c''a' & & b''c'-c''b' \\ c''a-a''c & & c''b-b''c \end{array}$$

$$\therefore y=\frac{(a'c-c'a)\,d''+(a''c'-c''a')\,d+(c''a-a''c)\,d'}{(a'c-c'a)\,b''+(a''c'-c''a')\,b+(c''a-a''c)\,b'}$$

$$x=\frac{(b'c-c'b)\,d''+(b''c'-c''b')\,d+(c''b-b''c)\,d'}{(b'c-c'b)\,a''+(b''c'-c''b')\,a+(c''b-b''c)\,a'}$$

There is obviously no necessity for separating the work into three distinct portions, as, for the sake of greater perspecuity, is done in the preceding illustration; for the whole may be as readily presented in a single compact form.

Although, as before stated, the foregoing process is recommended chiefly for the facility with which it enables us to write the above general forms for x, y, and z, when the coefficients are expressed by letters, yet in the case of numerical coefficients, the method still seems preferable to that in common use. In applying it in such a case we may suppress any factor which may happen to be common to the coefficients in either of the two vertical rows that supply our binomials; and these binomials themselves may also be freed from common factors. The following example is taken at random:

$$\begin{aligned} 2x+4y-3z-22&=0 \\ 4x-2y+5z-18&=0 \\ 6x+7y-\ z-63&=0. \end{aligned}$$

Suppressing the factor 2, common to the first vertical row of coefficients, we proceed to the determination of z thus:

$$\begin{array}{l} 1+\ 4 \\ 2-\ 2 \\ 3+\ 7 \\ \hline 8+\ 2= \quad 10 \text{ or } \ \ 2 \\ -6-14=-\ 20 \text{ or} -4 \\ 7-12=-\ \ 5 \text{ or} -1 \end{array}$$

$$\therefore z=\frac{2\times 63-4\times 22-1\times 18}{2\times -1-4\times -3-1\times 5}=\frac{20}{5}=4$$

In such particular examples, I think it to be not advisable, in general, to deduce more than one of the unknowns in this way. I should prefer, when the value of one is obtained, to substitute that value in two of the equations, and then to derive the other values from the form for *two* unknowns, which form is got with little or no trouble by proceeding in a manner analogous to that above: thus—

$$\begin{array}{l} ax+by+c=0 \\ a'x+b'y+c'=0 \\ \hline a'-a \end{array}$$

Instead of binomials, we here have two monomials, a' and $-a$; which we write horizontally; the factors, introduced as before, give for y

$$y=\frac{a'c-ac'}{a'b-ab'}$$

And, in like manner, for x

$$x=\frac{b'c-bc'}{b'a-ba'}$$

If in the preceding numerical examples we put for 2 its value 4, we shall then have to deal in this way with the expressions

$$\begin{array}{l} 2x+4y-34^{*} \\ 4x-2y\times 2 \\ \hline 4-2\ |\ -2-4 \end{array}$$

$$\therefore y=\frac{4\times -34-2\times \ \ 2}{4\times \ \ \ 4-2\times -2}=7; \qquad x=\frac{-2\times -34-4\times 2}{-2\times \ \ \ 2-4\times 4}=3$$

It would be easy to show how the method here explained might be applied to the general case for four unknowns, and thence to that for five, and so on. But, as already observed, the formulæ for these cases possess but comparatively little interest.

J. R. Young.

Belfast, October 7, 1847.

SHORT METHODS IN GAUGING.

Sir,—As a practical man, I have found the two following "Rules" exceedingly useful in ascertaining the mean diameters of spherical and other frustums, viz.:

$$1 : \tfrac{1}{8} :: 1000. : 125.000$$

$$.5 : \tfrac{1}{16} :: \ 500 \ : \ 62.500$$

These are the ratios upon which the rules are founded,

1st. Rule,—100. : 125.0 :: (C—L) : $cx+\frac{1}{2}(a+b)$ = mean diameter.

2nd. Rule,—62.5 : $(a+b)$ :: (C−L) : $cx+\frac{1}{2}(a+b)$ = mean diameter.

Wherein C = the length of the *curve* of frustum.

L = the axis, or direct length of the frustum.

a = the head diameter.

b = the bung diameter.

cx = the fourth term in the proportion:

---

* Each of these expressions may be divided by 2: but it is not necessary to more than advert to these obvious reductions.

.. being added to half the sum of nd bottom diameters = the mean ter of the frustum.

1st Rule is to be applied when the ure at the *quarter* of the frustum h or spherical; and the 2nd, when s not the fact. I am, Sir, &c.,

JOHN WITFORD, *Gauger*.

sworth, August 2, 1847.

MAN'S PATENT DEODORIZING AND DISINFECTING PROCESSES.

atent was sealed on the 6th inst., name of Mr. Charles F. Ellerman, certain processes or methods of ing feculent, excremental, and matters inodorous and disinfective, lso for retarding the putrefaction mal and vegetable substances, and chemical re-agents employed in d processes or methods."

processes of Mr. Ellerman are, lieve, identical (or nearly so) with of M. Edmond Dam, of Brussels, I. Coutaret, of Paris, at both of places they have acquired a high of celebrity for their efficiency—llerman having taken out the En- atent in the interest of M. Dam, s the real inventor, and M. Cou- lone the like service as regards e.

he course of last month Messrs. ian and Dam went to Liverpool the sanatory question occupies a in the attention of the public, only to that of the monetary re) and performed a number of ex- ents, with their re-agents, at the uses, in the presence of Mr. the Superintendent of Liverpool, Newlands, the engineer of the gh, Dr. Duncan, the borough's al officer of health; Dr. Suther- Dr. Watson, Dr. Swift, Mr. Hig- (surgeon), Dr. Cooke (surgeon), ther gentlemen. The testimonials hed by these eye, or rather nose ses, are highly satisfactory—more ed than any we have yet met with tion to this subject.

srs. Fresh and Newlands say, in a rtificate: "A quantity of the re-agent oured upon a collection of nightsoil cesspool of a privy. The smell from atter before the experiment was in- le, but in a short time after the appli- of the liquid the fœcal smell had disappeared, and the only perceptible odour was that of the re-agent itself, which is not disagreeable."

Dr. Watson.—"I have great satisfaction in bearing my testimony to the facts which these experiments fully realised, viz., a rapid and complete change in the chemical constitution of the filth acted upon by a small relative quantity of the re-agents employed by Mr. Charles F. Ellerman, rendering the substances *inodorous* (if we except a faint, sourish, but non-permanent smell derived from the re-agent itself) and thereby it may be presumed comparatively, if not absolutely, *innocuous*; whilst the *agricultural properties* are doubtless *greatly improved*, developing a process for the main purposes of social economy, doubly valuable."

Dr. Sutherland.—"I have no hesitation in stating that the effect was the almost immediate removal of the odour proceeding from, apparently, two cubic yards of very offensive nightsoil, by the addition and proper mixture of a few pints of the re-agent."

Mr. Higginson.—"Having witnessed Messrs. Ellerman and Dam's experiments in this town on depriving nightsoil and stable manure of their noxious odours, I am happy to have it in my power to say that those experiments were quite successful and convincing. Five trials with different liquids were made at the Infirmary on offensive matters from an open privy and a closed cesspool, with complete success; all smell but that of the re-agent (itself not unpleasant) was speedily removed, and continued so the next day, with one slight exception in which the weakest of the liquids had been used. The same complete success resulted on a larger scale when a privy was operated on at the almshouses, the offensive animal odour entirely disappeared in a very short time. Stable manure was likewise deprived of its pungent smell by simply watering it with a solution of the re-agent. With these facts before me, I cannot but think that the authorities of Liverpool might, with great benefit to the town, adopt or recommend this plan for depriving offensive matters of their odour before removal by the scavenger, particularly if we may rely on the assurance of Mr. Ellerman, that the cost of the re-agents is *exceedingly small*, and that the addition of them very much *increases the value* of refuse matters as MANURE to the farmer and gardener."

Dr. Duncan contents himself with adding his "testimony to the success of Messrs. Ellerman and Dam's re-agent in removing the offensive odour of the nightsoil operated upon."

Mr. Cooper certifies "that on Saturday, the 25th of September of the present year,

he witnessed at the Liverpool Infirmary some experiments made upon rotten horse manure and upon privy soil with the Anti-mephitic Liquid preparations of Mr. Ellerman and Mr. Dam, that they were completely successful, having at once removed all disagreeable odour from the said manure and soil."

Dr. Swift.—"I have great pleasure in adding my testimony to those already given by my respected colleagues of Liverpool, as to the successful experiment performed by Messrs. Ellerman and Dam in disinfecting, or rendering inodorous, the contents of a privy in the almshouses of this town; and I sincerely trust that it may be brought into general use in all the towns of England, as it must contribute to the health of the inhabitants, by destroying the fœtid smell arising from a collection of filth in the different cesspools, &c."

The French Minister of Commerce and Agriculture awarded this year to Monsieur Coutaret, of Paris, a *gold* medal, for having manufactured, by Mr. Dam's process, the best manure in the department of the Moselle.

The composition of the re-agents employed by M. Dam will of course remain a secret till the enrolment of Mr. Ellerman's specification.

HOW TO RAISE THE BRITANNIA TUBULAR BRIDGE.

Sir,—As doubts have been expressed by high authority respecting the practicability of raising the Britannia Tubular Bridge to its position in the line of railway, I beg to send you a rough outline of a plan for effecting that purpose, and which plan will, I think, be admitted to combine safety, economy, and expedition.

It will no doubt be granted that where there is motion there is power, and where there is natural motion which can be made available in furtherance of engineering projects, and which may be had gratuitously, it is unwise not to make use of it.

The principal feature of the proposed plan consists in making use of the rise and fall of the tide as a moving power to place the tube in its position.

The tube being placed upon a raft at the foot of the piers, connect a sufficient number of chains to each end of the tube, in such a manner that the strain would not collapse the ends of the tube. Pass these chains over the top of the piers, and connect them to rafts, dumb barges, or vessels of sufficient weight at the other side of the piers. It will, of course, be necessary that the chains shall pass over friction-rollers on the top of the piers.

These arrangements being made, and the chains stretched tight when the tide is at the height, the receding of the tide would leave the tube and the counterpoising rafts or vessels at an elevation equal to the lift of the tide (which may be supposed 20 feet,) but by giving a sufficient preponderance to the counterpoising weights, the tube would ascend to the height of 40 feet, and the counterpoising weights would descend with the tide.

The next operation would be to support the tube in its elevated position until the chains are again tightened at the next high tide. For this purpose it would be necessary, during the construction of the piers and abutments, to build into the masonry several rings (perhaps the shanks of anchors, or something similar, with rings attached,) and to these rings might be attached, by short connecting chains and hooks, the various chains employed in supporting the tube. By this means the connection of the chains with the counterpoising weights would be set at liberty as the tide rose, and the tube would be supported by the short connecting chains attached to the rings. When the next tide rose to the highest point, the chains would again be attached to the counterpoising weights, and by the descent of these weights with the fall of the tide, the short chains would be disengaged, and the tube would be elevated 20 feet more.

This process would be carried on alternately, until the tube was brought to the required height, by simply using the rise and fall of the tide as a mechanical agent; an agent, too, which can be had for nothing.

As it is intended to carry the piers considerably higher than the level of the roadway, there will be no difficulty experienced in the execution of the above plan from a want of height in the supporting chains above the rise of the roadway.

Time will show whether the plans about to be adopted will be more efficient and more economical than the above.

I am, Sir, yours truly,

A. D.

YACHT SAILING.

r. Editor,—As Mr. MacGregor ne, in your 1,257th Number, if I am ed that the increased effect of my x sail was not owing merely to the ss of the plane portion of it, and l not have been lessened had the x part been cut away, I feel my- alled upon to reply negatively to estion.

here were a current of air passing ward of the sail in its direction, the x part of it would undoubtedly be detrimental, and the propelling would be wholly indebted to the rt of the sail, but as the lee part sail is wholly or partially *becalmed*, baft the after leech (which may be y drawing the shadow of the sail direction of the wind,) it follows he current of wind passing to wind- of the sail has a tendency, after g the after leech, to find its way he still or becalmed part, and to e its direction to a more favour- oint for forcing the vessel "ahead;" the current of air presses against nvex part of the sail, unimpeded resisting current in its opposite vity, doing mechanically more good ny other equal area of flat sail; there- t follows that I can have no doubt correctness of the theory. The on is, the difficulty of putting it into ee, and, in the attempt, the danger ng as much harm as good; for ex- , suppose for the sake of trying the iment, I make a sail a portion of a and form it into that shape, as near be, by the aid of elastic spreaders; he sail may be made to stand as a board, when not acted upon by ind, but in a breeze it becomes con- windward—not uniformly so, be- the boom does not bend, nor the s much as the spreaders, still it an imperfect convex sail.

w the question with me is, whether ditional weight aloft given by the lers (allowing for the superiority convex sail as a theory) does not much harm as good; and whether gular sail without spreaders, which have more canvas, to be of the weight as the other, would or would more efficient?—This could only ertained by very nice comparative iments between the respective sails. only say that my experimental boat, the *Revolver*, rigged with my re- volving mast and butterfly convex sail, never answered so well as when she was so rigged; and when a boat beats in sail- ing every one of her tonnage, one may conclude with just reason that the theory which is endeavoured to be carried out, cannot be wrong.

Should Mr. MacGregor be fond of making experiments with sails, I may suggest to him that lug sails are also well adapted for trying convex sails, which, by tight lacing, and the insertion of many elastic spreaders, may be made convex to windward.

I am, Sir, yours, &c.,

MOLYNEUX SHULDHAM,
Commander R.N.

Boulogne-sur-Mer, Oct. 19th, 1847.

CAST-IRON GIRDER BRIDGES.

Sir,—With regard to the first part of Mr. Dredge's last letter, I can only again remark, that I consider the reason- ing employed altogether unsafe, and un- acknowledged by any standard authority. As Mr. Dredge's acquaintance with writers on this subject is doubtless much greater than mine, he has probably met with such reasoning; but I should be surprised if in any mathematical work by any standard writer.

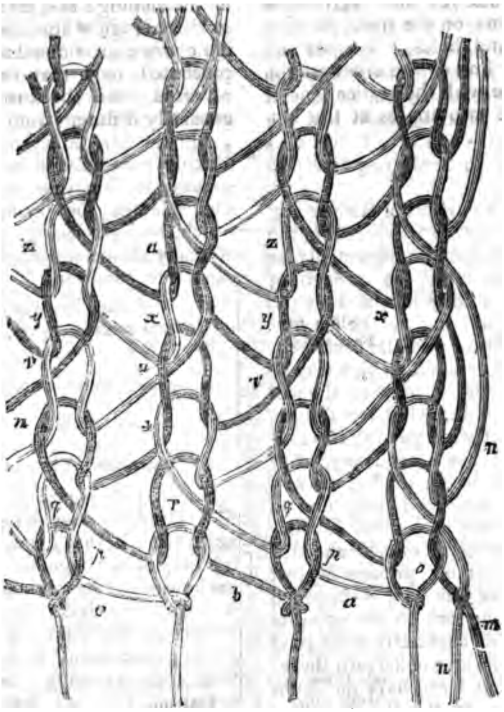
With respect to the other question, about the truss-rods, I asked whether the inclined bars, AC and BD (in fig. 2 of my first letter, page 153, and the same in fig. 2, page 222,) are not likely to give way much sooner than the longitudinal bars, CD? To this Mr. Dredge has not made any answer, and in his original paper he left this action altogether out of the account, apparently taking it for granted that these rods, AC and BD (AE and BF in Mr. Dredge's own paper in No. 1251,) would be sufficient to trans- mit the strain to the lowest horizontal bar.

Those of your readers who are interest- ed in this subject, will find the whole question of deflection of beams, &c., very clearly treated in "Moseley's Engineer- ing and Architecture," (Part V.)

I am, Sir, yours, &c.,

A. H.

IMPROVEMENT IN WARP NET FABRICS. BY JAMES S. GLOVER, IPSWICH, (UNITED STATES.)



Among the last reported American Patents there is one for an improvement in warp net fabrics, which will interest our Nottinghamshire and Leicestershire friends. The above figure will, along with the patentee's claim, make the nature of it sufficiently clear.

Claim.—"Having thus fully described my invention, that which I claim is the above specified mode of looping and interlooping, or interweaving, the several warp threads in opposite directions: that is to say, the advancing each thread towards the left and looping it twice, and passing each of the loops so formed through loops of the adjacent thread on the left; then reversing the direction of each thread, or carrying it towards the right, and forming two more loops upon it, and introducing said loops respectively through two loops of the thread immediately adjacent on the right, and so on throughout the whole fabric to be woven.

"I also claim the above-described manner of forming the selvages, or combining or uniting the selvage threads with one another, and the main warp threads, the same being represented in the drawing."

SHORT METHOD OF DETERMINING THE SLOPES FOR RAILWAY CUTTINGS.

Sir,—If any of your readers have ever had the task of *laying on the slopes* to cross-sections of a railway or canal, they will agree with me that it is most tedious work, from the number of distinct operations to be performed. The following description of a method of abridging much of this work may perhaps be worthy of their notice.

The common way of laying on the slopes (say for *cuttings*) is by drawing lines upon a piece of paper, (as in fig. 2,) the two sloping ones representing the sides of the cutting. The depth of the cutting being then scaled off on the vertical line running down the middle of the cross-section, a line is drawn through the point which represents the base of

the cutting at right angles to the vertical line. The paper is then adjusted so that this horizontal line shall agree with the horizontal line on the scale, to effect which three round holes, *h h h*, are cut, and the vertical line of the cross-section is made to agree with the vertical line of the scale. The two angles at the bottom of the cutting are then pricked off, which gives the base, and the two points on the sloping lines, marked with circles, give the slope of the sides. The same is done when an embankment is to be represented, only that the scale is then reversed, and the base and slope are generally different from that of cuttings.

Fig. 1.

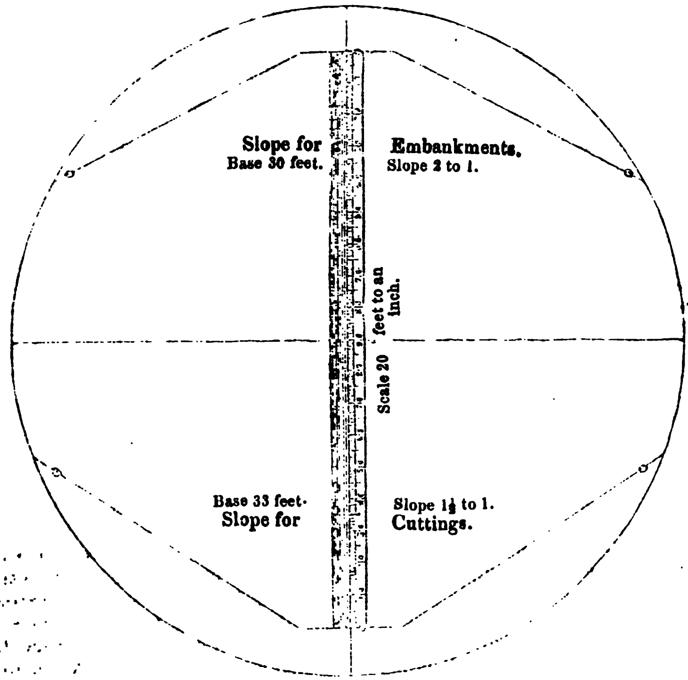
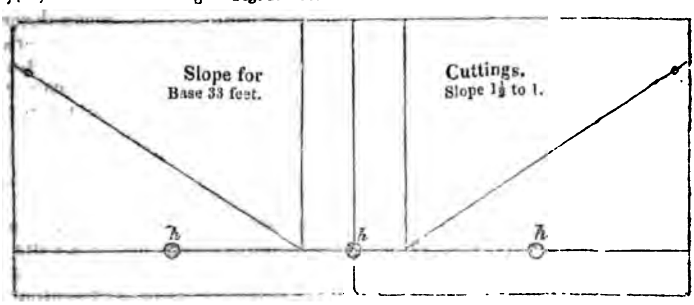


Fig. 2.—Scale 20 feet to an inch.



We have here three distinct operations, viz., the marking off on the vertical line the depth of cutting or height of embankment; the ruling a straight line through this point whereby to adjust the scale; and the setting and pricking off the slopes.

The improvement I would suggest is,

to have a scale, as represented in fig. 1, (where the shaded part is to be cut out,) running along the centre line of the scale, beginning from 0 and ending at 90 feet,—the deepest cutting which it is usual to make in earth. The scale adjusts itself by merely setting the division of the scale corresponding to the depth of the cutting upon the point where the cross section is intersected by its centre line. For example,—suppose the depth of cutting (or height of embankment) to be 25 feet: all that is necessary is to set the edge of the scale upon the centre line of the cross-section, and place the division, 25, on the centre of the cross-section, at the point where the vertical line meets it, and prick off the base of the cutting or embankment as well as the points indicated by the little circles.

Of course, for every different scale of feet there must be made a new scale on the slopes,—but these might be made with very little trouble, or even engraved, as the expense would be more than compensated by the time saved; this method occupying only *one-third* of the time which is required by the common one.

The slopes for cuttings and for embankments might be made separately; in which case, of course a piece would be left at top to join the two sides of the paper, which might otherwise lose their exactitude of slope.

I have only to add, that I have found this method perfectly satisfactory, and very far superior to the one at present in use.

I am, Sir, yours, &c.,
GEORGE KORBEZ.

Westminster, October 20, 1847.

RAILWAYS.—THE QUESTION OF RAILWAY FRICTION CONSIDERED IN RESPECT TO THE DRAWING AND DRAWN CARRIAGES.

Sir,—Some time ago I conceived the following plan of constructing railways, and beg now to submit it to the consideration of your readers:

The plan consists in having two longitudinal sleepers of timber laid the whole length of the railway, about 14″ × 7″, with their broadest face uppermost. I propose that the iron rails shall be fastened on the inside of the sleeper—at such a distance, of course, from the edge, as to insure their stability; thus leaving a broad space on the outside of the rail, on which the locomotive is to run with broad wheels, and flanges to prevent them knocking against the iron rail; on which last the carriages would run as usual.

I will now enumerate what I consider among the advantages of this system. By the engine running on wood, its tractive power would be greatly increased, there being so much more friction between wood and iron than between iron and iron; that is to say, an engine running on a wooden rail would draw a greater load running after it on iron rails, than if both were on iron rails. Evidently the present practice is wrong on principle. The wheels of the engines and carriages being made of the same material, they certainly should not run on the same rails; for we want friction between the engine and rails, but, if possible, none whatever between the carriages and rails. Now, by this plan, we should save great expense in the primary construction of a railway, especially in a hilly country, for we should be able to have much steeper inclines, and thereby save to a great extent tunnelling and cutting. We should also save in the quantity of iron for the rails, which would not require to be of near the weight they are now; for it is the heavy engine which causes at present the principal tear and wear of the roadway. Another advantage would be, that the iron rail would make it impossible for the engine to run off the line, provided always sufficient space were given outside the rails for the wheels to run on. A farther advantage would be the longitudinal bearing afforded to the iron rails, which would increase their rigidity, an give a more level surface for the carriag to run upon, and thus proportionally reduce the friction between the rails and carriages. At present the carriages may be literally said to be always running on inclined planes down and up between every two transverse sleepers.

I now come to speak of the disadvantages of my plan, which I know are many, though, I think, not such as to counterbalance the advantages.

The first expense in laying down such broad longitudinal sleepers would certainly be considerable, especially in this country, where wood is comparatively scarce. There would also be frequent occasion for relaying, which would cause great trouble and inconvenience, as well as expense. Indeed, I am not sure that

ilways already constructed the sub-on of this system would be at all ble. Neither is it to be concealed, o adopt it on any new railway which ›nded to communicate with some existing railway or railways, the on of the system would be open to me sort of objection made to the uction of the broad and narrow s on one line of traffic. Either the ce between the carriage wheels have to be altered, or else the dis- between the engine wheels. I . think it would be preferable to he latter altered, as then the car- could go from one end to the and thereby save the passengers ›uble of changing at the junctions. ›nly thing necessary would be to ›n engine in readiness at the junc- ation to carry on the train, which be economically managed by so ing matters that the up and down should reach the station at the time, so that the engine which ıt the up train to the station might with the down train, and *vice*

One objection, however, there mains to be noticed, which I much s almost insuperable; and that is, iction between the wheels of the : and the sleepers, which would be :essive with great weights, that if not cause fire, it would cause at very great wear and tear of the rs. The extent of this tear and would, I think, depend much on ode of seasoning the timber. I think that after the timber had l its moisture extracted, sulphate of ight be forced into its fibres with advantage; but this view of the I will leave to others to discuss.

I am, Sir, yours, &c.,

OSEG.

n, Oct. 19th, 1847.

ERS ON ANALYTICAL GEOMETRY. JAMES COCKLE, ESQ., M.A., BAR-ER-AT-LAW.

[Continued from page 361.]

.P. VII.—*The Elliptic Parabo- Unreal Surfaces; General Re-*

TION 1.—*The Elliptic Parabo-*

following propositions serve to ;uish this surface:

en a surface of the second degree : met in a point *by one and only one plane parallel to a given plane the surface is an elliptic paraboloid or a cone.*

When the position of such plane is determined by a linear *equation the surface is the* elliptic paraboloid.*

Whatever be the system of coordinate planes to which an elliptic paraboloid is referred, one of those planes possesses the following property;—viz.:

If it meet that surface in a point, no other plane can be drawn parallel to it so as to meet the surface in a point; or, *if it do not meet the surface in a point, one (and only one) plane can be drawn parallel to it so as to meet the surface in a point.*

The last proposition is true; for *all* the coordinate planes cannot be parallel to the axis of the paraboloid. The property belongs in general to no other surface of the second degree. When it has place in a system of coordinates to which a cone is referred we have already seen how to distinguish the latter surface. (Vol. xlvi., p. 322.)

Ex. (2). What surface is represented by

$$x=\frac{y^2}{l}-\frac{z^2}{l'}\,?$$

[Hymers,† p. 48, Art. 66.]

On inspecting this equation we see that the plane of yz (*i e.*, the plane denoted by $x=0$) meets the surface in the point $y=0$, $z=0$. And no plane parallel to that of yz meets the surface in a point. Hence, $x=0$ being a *linear* equation, the surface is the *elliptic paraboloid.*

SECTION 2.—*Unreal Surfaces.*

The surface represented by a given equation may be *unreal.* Thus, let us take

(*Ex.* 3) $x^2+3y^2+4z^2-6yz-2zx=a$

[Leroy, p. 164, No. 250.]

To reduce this equation I proceed as below:

x^2	zx	y^2	zy	z^2	1
1	-2	3	-6	4	$-a$
				1	
				—	
				3	
		3^2	-6.3	9	$-3a$
				9	
					$-3a$

---

* *Mechanics' Magazine*, vol. xlvi., p. 322.

† *Anal. Geo. of 3 Dim.* Camb., 1836.

This process shows that the given equation is equivalent to

$$(x-z)^2+\frac{1}{3}(3y-3z^2)-a=0.$$

Let a be *negative;* then, since the squares are essentially positive, no real values (positive or negative) of the variables can satisfy this last equation, and the surface is altogether *unreal.** By similar considerations an unreal surface may always be recognised.

SECTION 3.—*General Remarks.*

If, in the last equation, a be positive the surface is an elliptic cylinder;† if $a=0$ the equation last above given represents *a single straight line*‡ and, not a "surface." In fact, in order that we may avoid unreal quantities, we must, when a is zero, make

$$x-z=0, \text{ and } 3y-3z=0$$

separately; and we thus find the equation to the straight line to be

$$x=y.$$

Great Oakley, near Harwich, Essex,
October 21, 1847.

ON THE EMPLOYMENT OF HEAT AS A MOTIVE POWER.

Sir,—There are some inaccuracies and omissions in my last paper, one of which I will just mention here, before proceeding further with the series. At page 403, col. 2, I have inadvertently written, "If the two gases expand equally for the *same quantity of heat,*" whereas what is given by experiment is the equality of expansion for the *same range of temperature.* That part, therefore, requires correction thus:—Let C and C′ be the quantities of heat which raise equal volumes of the two gases under the same constant pressure through the same temperature. Then

$C=P.h+N.R\ (p'-p)$ for one gas,

$C'=P.k+N.R\ (p'-p)$ for the other.

And since by experiment $.h=k$ $\therefore$ $C=C'$, or the specific heats, are equal.

There are other points requiring further elucidation: the whole having, in fact, been written more as a series of miscellaneous remarks than anything else. In the meanwhile I am very glad to see, by Mr. Dredge's letter (which I have not had time as yet to read,) that my object has been gained of inducing others of your correspondents to take up the subject. In entering upon a region so entirely new and untrodden, it may be expected that frequent slips will be made by all of us, and we must help one another on as well as we can.

A. H.

THE MATHEMATICS OF PHRENOLOGY.—GENERAL TOM THUMB.

Having been favoured (Feb. 7, 1846,) with a deliberate examination of that "man in miniature," Master Charles S. Stratton, the individual called in the advertisements "General Tom Thumb," I found him to be a great curiosity, on account of the size of his head. His age was stated to be fourteen years, and I have much reason to believe the statement to be correct. Judging from external appearances, the bone and integuments are slightly thinner than in the average of male heads; I therefore estimate these at twenty-six, the average being thirty, cubic inches. This deducted from the entire side of the head, leaves forty cubic inches as that of the brain,—being the smallest recorded human brain capable of sane and somewhat vigorous mental manifestation; for such does the possessor exhibit. My previous researches for the smallest head, at, or above, seven years of age, (the period at which, according to the erroneous statements of Tiedemann, Hamilton, the Wenzels, and others, the human brain attains its full size,) are stated, in my "Contributions to the Mathematics of Phrenology," as follows:—"After ten years' practice in observation, during which I have measured more than 3,000 heads, and formed an eye estimate of more than ten times that number, measuring every head in any way remarkable to which I could obtain access, I have to report the following as unique in my experience, in the respective classes to which they belong. Mr. L——, a gentleman of talents and learning, size of head 111 cubic inches; C. A ——, aged sixty, a village orator, politician, wit, poet, and tinker, a little above 100; Robert Duncan, aged twenty-nine, found employed in a large manufactory, 92; and Robert Gibson, a pauper, found in a public soup-kitchen, size of head, 82 inches." "General Tom Thumb" is a very favourable specimen in most particulars. The anterior and coronal regions are slightly below an equal balance. The cerebellum seems to be very small, as

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* Leroy, *Analyse, &c.*, p. 165.

† Ibid, pp. 164—5. See also *Mech. Mag.*, vol. xlvi., p. 823, *Ex.* (η.)

‡ Leroy, p. 165.

Addendum to CHAP. VI.

Supra, p. 360, at the foot of the page add the following note:

(b′) See next note.

Addendum to CHAP. II.

Vol. xlvi., p. 248, col. 1, line 9: after "single" add *and not parallel to one another. Et vide,* vol. xlvi., p. 293.

ive, indeed, as I have ever seen in an ; of six months. In this particular the eral" is a very remarkable case against octrine held by some, that the cere-a is connected with the regulation of ılar action; for if there be any one more than another, for which he can d to be remarkable, apart from his ative size and fine proportions, it is ntrol over muscular action; his sys-aving attained a degree of firmness, th, and maturity, quite equal to, or beyond, the average of his age. He short, a case of unusual interest to the ological world. He affords the ex-ly rare opportunity of solving one on in the great problem:—What it of manifestation is a well-balanced ealthy head of a given size capable of sting? He is certainly very near, if es not actually touch, the extreme point on the scale of size. What, is a head of sixty-six, or a brain of cubic inches, capable of attaining in ircumstances?—*Mr. J. Stratton.*— *Journ.*

LEATHER TRADE OF THE UNITED STATES.

[the Report for 1846 of the American Insti-to the Legislature of the State of New —Mr. Charles M. Leupp, Reporter.]

is great branch of domestic industry, ng, in value and extent, with those of , wool, and iron, claims a high position g the manufactures of the State of New . Our commercial metropolis imports istributes a greater number of foreign than any other city in the United , and a larger number of *sole leather* ary hides, than any other city in the , while our inexhaustible forests of ck, abundance of water power, and fa-s of transportation, secure us advant-beyond those of any other State in the n.

is only within the last thirty years that York has become the manufacturer of leather for other states and countries. ously, and indeed subsequent to 1815, ere mainly supplied with oak leather the States of Pennsylvania, Delaware Maryland, while Massachusetts and ont furnished us with hemlock leather. paratively little leather of oak tannage nufactured in this State, owing to the ity of oak bark and its inferior strength nning purposes. We still continue to re the principal part of our oak leather the Southern and Western States, the oak tree is found growing in greater tities and strength.

In regard to hides. While our imports of foreign, chiefly from South America, do not on an average exhibit much falling off, (the average of the past ten years being 692,000 annually,) our domestic hides have increased largely. The prairies of the West seem capable of growing cattle almost as abundantly as the campaynas of South America, and the tanneries of the Western States and north-western part of the State of New York, which formerly drew their supplies of foreign hides from the city of New York, are now almost exclusively stocked with hides, the produce of the countries bordering on the lakes. Canada, which in past years derived large supplies of leather from the city and state, now receives only her stocks of foreign hides from here; while by duties, which are in effect prohibitory, and with the advantage of a drawback of five per cent. on foreign hides imported through the State, she is enabled so supply herself with leather from her own tanneries cheaper than we can furnish it.

Since the removal of duties on leather in England, considerable shipments of oak and hemlock have been made to that country, but owing to the fact of its being a new article with the quality of which the consumers there were unacquainted, it met with but partial favour and dull sale. The system of economy so rigidly carried out there, demands that we should prepare our leather to suit their wants and prejudices. Instead of being shaped in sides, with the head and offal attached, they prefer it in BUTTS—in other words, the hide so trimmed as to be free from head, shanks, and other less valuable parts, which are used for different and inferior purposes. Several parcels have been so prepared, and immediately met with ready sale at remunerating prices, and extensive stocks are now in process of tanning, especially adapted to the English market. Our superior natural advantages in the cheapness of hides, bark, and facilities for tanning, render it certain that we shall supply that country with leather. The difference in the cost of bark alone is as five to thirty, and bark constitutes one-third of the cost of tanning in this country, and much more than that in Europe.

The opening of this business to us in England will act as a powerful stimulus to our tanners to excel in their trade, for although improvements in quality, and economy in the art of tanning, have been steadily advancing, we have not made that rapid progress which ought to have resulted from our natural advantages. The mass of consumers in this country prefer an inferior article at a low price, rather than a good article at a high price—in other words, they will wear

out two pairs of poor shoes in preference to one pair of good ones, notwithstanding the latter may be intrinsically the most lasting and serviceable. In England, the reverse of this is the case. There, consumers will wear the best and most durable, because they are in fact the cheapest.

The display of leather at the last Annual Fair was unquestionably the best yet exhibited, and nearly all the articles shown challenge competition with the like manufactures of any country in Europe. The French have heretofore excelled us in the manufacture of calf skins, mainly in one or two particulars, toughness and mellowness being the chief. Those exhibited at the Fair, rival the French skins in both these respects, and in fineness of finish excel them. Our bark-tanned sheep skins are decidedly superior, both in beauty and intrinsic excellence. In japanned leather, the Germans and French still maintain their supremacy, but we are confident they must speedily yield it.

We deem it proper before closing these remarks, to allude to two specimens of band leather, each of like excellence, and both superior in every particular to any used in Europe. Indeed, we know of applications from England for this very article, but owing to the fact of there being a heavy duty on "articles of Leather cut into strips," which band leather is, we have not been able to introduce it there to any extent. We anticipate, however, that it will find a market there before long, and to the mutual advantage of both countries.

We annex a table showing the quantity and value of Sole Leather inspected in the city of New York from 1827 to 1846 inclusive. The quantity is taken from the returns of the State Inspectors, and the value is determined by estimating the weight and price, assuming as a basis the average weight and price realized by one of the most extensive houses in that branch of business in the city of New York.

TABLE *showing the Quantity and Value of Sole Leather inspected in the city of New York from* 1827 *to* 1846 *inclusive.*

Year.	Number of Sides.	Average weight of Side.	Total No. of pounds.	Average price cents 1-100.	Value. Dollars.	Cents.
1827	265,353	13	3,449,589	18,55	639,898	75
1828	284,978	13 1-4	3,775,958	19,61	740,465	36
1829	264,878	14 1-4	3,774,511	19,61	740,181	60
1830	326,298	16	5,220,768	19,61	1,023,792	60
1831	440,000	15 3-4	6,930,000	20,67	1,432,431	00
1832	667,000	14 1-4	9,504,750	18,28	1,737,468	30
1833	882,609	15	13,239,135	16,69	2,209,611	63
1834	828,175	15 3-4	13,043,756	14,57	1,900,475	24
1835	784,165	16	12,546,640	15,63	1,961,039	83
1836	925,014	16	14,800,224	18,28	2,705,480	94
1837	890,962	15	13,364,430	16,96	2,266,607	32
1838	749,556	15 1-5	11,393,251	18,02	2,053,063	83
1839	772,255	15 1-3	11,841,243	19,25	2,279,439	28
1840	638,112	15 3-4	10,050,264	17,22	1,730,655	46
1841	687,101	17	11,680,717	17,66	2,062,814	62
1842	886,868	17	15,076,756	15,	2,261,513	40
1843	867,210	17 1-2	15,176,175	14,46	2,194,474	90
1844	1,048,770	16 9-10	17,724,213	14,38	2,548,741	82
1845	1,037,500	17 1-2	18,156,250	13,01	2,362,128	12
1846	1,074,256	16 8-10	18,047,500	12,	2,165,700	
	14,321,060		228,796,130		37,015,984	00

"SOLUTIONS OF TRIGONOMETRICAL QUESTIONS." BY THOMAS GASKIN, M.A.

It may safely be asserted, that no student can become thoroughly acquainted with the utility of any branch of the mathematics without solving a considerable number of questions. He may get up the mere elements—and this acquisition, as a mental exercise, has its advantages; but it is the exercise of solving a variety of

ss which gradually enables him to one part of the mathematics to explain r, or to employ it in the actual affairs. It would be difficult, perhaps imle, to form an accomplished mathen except by the process of problem ;. A person cannot be said to be well in mathematical science unless he how to apply it; every variety of ation forms a problem,—hence, the n of problems constitutes the very subn of a mathematician's credit. Know e may of the mathematical sciences in stract, if he cannot apply them, it be absurd to term him a mathemati- True, such a person may possess a of material, but he cannot convert it ything useful—the coin is of sterling but the owner is unable to make it urrent.

ibridge, at the present moment, holds inent position in the mathematical During the last thirty years this sity has effected much towards oblig the stigma which at one time d to this country in reference to natics as compared with the continent, been mainly instrumental in forming of the first philosophers and mathens of the age. Now it may be safely d, that Cambridge could never have ed this eminence but for the practice blem solving which it has brought gue. The examples in the differential tegral calculus and finite differences cock, Herschel, and Babbage, deserve particularly named. This splendid f cantabs have, by the highly meritoublication to which we allude, entitled lves to the lasting gratitude of the uni-, and to the deep respect of all British ts. The publication was well adapted e, and it has had, great influence in g accomplished analysts. It puts in udent's possession the principal ana- theorems and problems which have sed the skill of the most profound maticians that ever existed. Although abours are necessarily condensed, the t is nevertheless supplied with a sufficient inlet into the nature of the propositions, to enable him to comprehend their elegance, and to see their general application.

Cresswell, Bland, and others of lesser note, deserve credit also for their compilations. Even Bland, though he has copied largely from the diaries and similar publications down to their veriest blunders, without ever naming the sources that had supplied him with the whole matter of his work, has effected some good. Some of the unfortunate Wright's publications have done service, especially to the self-taught class of students. Nor must Mr. Hind be forgotten; the collections of problems in his works have been useful at the university, and also to students who have to teach themselves. The lamented Mr. Gregory's publication very appropriately fills up the vacancy occasioned by the scarcity of Messrs. Peacock, Herschel, and Babbage's work. Mr. Walton's "Mechanical Problems" is one of the most interesting mathematical works in the language. There are other publications of the same kind, each deserving more or less commendation.

Nor must we omit to mention Professor Davies's edition of "Hutton's Mathematics:" the work is considered the country student's text-book; the professor's solutions of an immense number of problems in the key to the work, are quite models of their kind. The work has had, and is likely to have, very great influence in forming a correct taste in self-taught students.

"Hind's Trigonometry," and one or two more treatises upon the same subject, furnish the student with a considerable number of questions for exercise; but he is left to work out the solutions as he best can. Hitherto there has been no problem book exclusively on trigonometry; and yet there is, perhaps, no part of the mathematics, the application of which is so extensive as that of trigonometry. Physical problems of almost all descriptions depend entirely upon it; the celebrated result showing the stability of the universe rests on an established law of lines and cosines. It is obvious,

therefore, that a thorough knowledge of trigonometrical formulæ, together with a familiar acquaintance with the best mode of applying them, must be of great importance to the mathematical student.

The undergraduates at St. John's College, Cambridge, at the end of their fourth term of residence, undergo an examination in trigonometry—*vivâ voce* with regard to mere book-work, after which comes a paper containing problems, some of which are generally unique, and the whole sufficiently interesting and difficult to test the student's taste and acquirements. These examination papers of the college generally, and of St. John's in particular, in the course of time, constitute a mass of problems of first-rate utility to the student; they are indigenous to Cambridge, and cannot be obtained completely elsewhere.

Mr. Gaskin, in the book named at the head of this article, has published the trigonometrical questions which have been proposed at St. John's College during the seventeen years from 1829 to 1846, together with their solutions. Such a work was not only wanted at Cambridge, but it will be serviceable to teachers and self-taught students all over the country. To assist the student, he has endeavoured to point out the form in which he would be expected to present the solution to the examiner. And for the advantage of the self-taught, the problems of each year are published separately from the solutions, so that the student can see how far he can go with any set, by his own unassisted efforts, before he turns to the solutions. The whole of the solutions are extremely neat, and many of them might be pointed out as unrivalled for simplicity and clearness.

Mr. Gaskin is peculiarly qualified for the task he imposed on himself in undertaking this work. We happen to know that even in his earliest years he had a taste for trigonometry, and a very extensive acquaintance with its application. When yet a mere boy he invented a demonstration of Shuiller's celebrated theorem for the spherical excess (as this demonstration is much more simple than that in "Legendre's Geometry," "Hind's Trigonometry," &c., we will take an early opportunity of laying it before our readers.) In a brief and interesting relation of the wonderfully early acquirements which our author had made, which is now before us, it is said, "When the age of this child is compared with his scientific attainments, we can look on him in no other light than as a literary phenomenon, who promises to become an ornament to one of our British universities." The writer's prophetic conjecture has been fully realised. Mr. Gaskin is now one of the most accomplished mathematicians of the day. His ingenious mode of solving differential equations, and of integrating expressions hitherto deemed impracticable, may be seen in "Hymer's Treatise on Differential Equations," and in other places. Mr. Gaskin is still at Cambridge, and the heads of the university have lately, we believe, for the fourth or fifth time, appointed him to be one of the moderators. The university acts discreetly in placing men of such splendid attainments in prominent positions; and we trust it will continue to exert all its official and social influence in the same direction.

We strongly recommend Mr. Gaskin's book to all mathematicians, students, and teachers.

CURR'S "RAILWAY LOCOMOTION AND STEAM NAVIGATION."

We have received a very long letter from Mr. Curr, on the subject of our review of his book. He finds fault with it, of course; for what bemauled author ever yet kissed the rod wherewith he was chastised? "I do not," he says, "ask the insertion of this in your Magazine as a favour, but demand it as an act of justice;" but with the manifest purpose at the same time (for M. Curr is no simpleton, whatever else) of rendering compliance with his request impossible, he has interlarded every passage of his letter with terms of abuse too gross for insertion in the pages of any respectable journal. One or two things in the epistle we must, nevertheless, in fairness to ourselves, and in despite of Mr. Curr's insolence, advert to in a general way. He accuses us of a misrepresentation of his notions about friction, which misrepresentation amounts to this—that if Mr. Curr is to be understood as using the word "friction" in its ordinary sense, it is no misrepresentation at all. If a man chooses to use old words in new senses, whose fault is it if he be misunderstood? On expansion he makes some remarks, which, cleared from their share of the expletive scurrility common to the epistle, are to this effect:—"The assumption that the pressure is inversely as the volume, is only true when the temperature remains the same; but the tempera-

es not remain the same in the steam-engine, erefore the law does not apply." This is e and true, and about the only thing in the hat is so. It is evident, however, that the an has learnt this very fact from the review for in his book he displays a palpable ignof the laws usually called Boyle and Mar. Besides he has forgotten that this is ily stated, and the results obtained only into apply *with* that exception or correction—t, only as an approximation—the fact being, real and rigorous law of connection between e, temperature, and volume is unknown. Mr. Curr not knowing that the relation bethe three quantities, though unknown ri o-has been expressed by empirical formulæ for practical purposes, has written a great deal of nonsense of his own about it (assuming the particles of steam to be of a "shape between the cube and sphere!") He defends, too, his absurdities about the thermometer in a way which shows, if possible, more glaringly than his book, that he knows and understands absolutely nothing about it. Two thermometers cannot be both true, if one particular point on their scales be not engraved with one and the same symbol or number!!! Whereas, it would not matter one jot (except as a matter of inconvenience in expressing degrees of one in terms of another,) if every thermometer in the world were marked with different numbers at the melting point of snow, or any other point.

OF PATENTS GRANTED FOR SCOTLAND FROM 22ND OF SEPTEMBER TO THE 22ND OF OCTOBER, 1847, INCLUSIVE.

ony Bernhard Von Rathen, of Putney, Surgineer, for certain universal wheels, or imdirect rotary engines to be worked by steam, any other elastic power. September 27; nths.

ge St. Dodge, of Attleborough, in the State achusetts of the United States of America, ain new and useful improvements in machir spinning and winding yarn. September months.

niel Card, of Manchester, Lancaster, cank maker, for certain improvements in maer apparatus for twisting, twining, or cturing cords, bands, twines, and other articles from cotton, flax, hemp, silk, and fibrous substances. September 28; six .

ey Smith, of the town and county of Not-, engineer, for a certain improved apparatus ermining the pressure of steam in boilers, ulating the dampers of a furnace. Septemsix months.

h Henry Tuck, of Paris, gentleman, provements in apparatus for ventilating gs, carriages, chimneys, and other places where a change of air is required. October 4; six months.

James Napier, of Shacklewell-lane, Middlesex, operative chemist, for improvements in smelting copper and other ores. October 7; six months.

Thomas John M'Sweeny, of Gould-square, London, gentleman, for improvements in steering ships and other vessels. October 7; six months.

William Hutchison, of No. 3, Wakeling-terrace, Saint Mary, Islington, Middlesex, marble merchant, for improvements in processes for hardening, polishing, colouring, and rendering stone impermeable; applicable also to other substances. (Being a communication from abroad.) Oct. 12; 4 months.

William Thorpe Stevenson, of Upper Bakerstreet, Lloyd-square, Middlesex, gentleman, for improvements in regulating the generating of steam in steam-boilers. October 12; six months.

Stirling Robert Newall, of Gateshead, Durham, for certain improvements in machinery for grinding grain, paints, and other substances. October 21; six months.

John Lane, of Oriel-street, Liverpool, brewer., for improvements in railway carriages and engines October 21; four months.

WEEKLY LIST OF NEW ENGLISH PATENTS.

am Kirrage, of Warner-place, Hackney-road, sex, for an improved combination of mater building purposes, and a new application in materials for building purposes. October months.

rd Barker, of Budleigh, Salterton, Devon, ian, for certain improvements in the prepaof manure. October 26; six months.

am Thomas, of Cheapside, merchant, for improvements in the construction of stays, machinery for manufacturing stays; parts h machinery are applicable to other species ing. October 26; six months.

ge Petrie, of 14, Mountford-sttreet, Whitechapel, Middlesex, for certain improvements in electric telegraphic apparatus. October 26; six months.

Charles Carey, of Churchyard-row, Newington-butts, Surrey, gentleman, for improvements in obtaining infusions or extracts from coffee and other matters. October 26; six months.

Jean Jayet, of Paris, engineer, for certain improvements in calculating-machines. October 28; six months.

Edward Evans, of the Haigh Foundry Company, Wigan, Lancaster, for improvements in wheels for railway and other carriages. October 28; six months.

WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

f a-	No. in the Register.	Proprietors' Names.	Addresses.	Subjects of Designs.
1	1236	John Rock Day, and William Benjamin Denton	Walworth	Handle for tailor's goose, or other iron.
,,	1237	Henry Samuel Ellis	Exeter	Safety-chain brooch.
2	1238	John Cherry	Murray-street, City-road	Candle-lamp spring detainer.
,,	1239	William Smith	Princes-street, Haymarket	Wrench or spanner.
5	1240	Henn and Slater	Birmingham	Improved parasol and umbrella furniture.
,,	1241	Charles F. A. Rider	Redcross-street, Borough	Expanding and contracting hat lining.
,,	1242	James Bates	Derby-road, Kingsland-road	Tooth-brush.
6	1243	Captain George Smith, R.N.	United Service Club, Pall-mall	Marine life and property preserver.
8	1244	Charles Iles	Bordesley, Birmingham	Hook.

Chemical Apparatus.

MESSRS. GRIFFIN AND CO., respectfully announce that, in addition to their Establishment in Glasgow, they have now opened a Warehouse in London, for the sale of Chemical and Philosophical Apparatus, Geological Specimens, and other requisites for Scientific Researches. A large assortment of apparatus, specimens, &c., may at all times be seen in their museums. Complete collections provided on short notice for Home or Foreign orders.

John J. Griffin and Co., Chemical Museum, 53, Baker-street, Portman-square, London, and Richard Griffin and Co., Glasgow, Proprietors and Publishers of

"The Encyclopædia Metropolitana."

Dredge's Improved Furnace and Registered Fire-Bar.

For Licences and Particulars apply to Mr. DREDGE, 10, Norfolk-street, Strand, London.

Cunningham & Carter's Pneumatic Railway System.

THE SYSTEM OF PROPULSION, now submitted to the notice of the Public, differs essentially from all the plans hitherto tried or proposed, and is considered to be WHOLLY FREE from the PRACTICAL DIFFICULTIES which have so seriously retarded the application of atmospheric power.

The carriages run upon lines of rails, constructed and laid down as usual, but their propulsion is effected through the medium of rails, attached to the sides of the carriages, which derive their motive force from being brought into contact with the peripheries of a succession of revolving horizontal wheels, placed in sets of three each, at distances of about 300 feet apart—one wheel being placed outside of each line, and the third in the space between the two lines—all three being connected and put simultaneously in action by air-engines, suitably mounted; these communicate with an atmospheric main, common to the whole series of engines, laid down outside the rails, beneath the surface of the ground.

The shafts of the three horizontal wheels revolve in proper bearings, within an iron case, fixed in a trench beneath the rails, and extending transversely into the banks. The case being made in sections, can be laid down with great facility: it protects the inclosed machinery from injury, from wet or dust, or interference—while access may be readily had to the interior, for the purposes of inspection or repair.

The propelling wheels are themselves all above the ground.

Among the numerous ADVANTAGES arising from this arrangement, the following may be stated:

The PROPELLING WHEELS being above the rails, no alteration will be required in the rails or carriages, as now constructed.

The PRIME MOVERS, or STATIONARY ENGINES, may be situated wherever fuel is cheap, or water power exists; and, as they all work into the main tube, no delay to the traffic can occur through the derangement of either of them.

POWER being always in readiness, TRAINS may follow each other in rapid succession—while their starting may be so regulated, independent of the drivers or guards, that it shall be impossible for one train to overtake, or come in collision with, another.

As the number of revolutions of the propelling wheels, and the degree of adhesion of the same, may both, or either of them, be increased or diminished at pleasure, independently of the prime movers, an engine, or engines, will be capable of a greater range than at present.

By this system any kind of work can be performed, as the engines work equally well each way.

No unpleasant effects from gas, steam, or cinders.

Perfect safety secured, by fixed and self-acting arrangements, out of the reach of interference, and entirely independent of attendants.

Great economy in the formation of new lines, from reduced weight of rails and general cost of works, where no locomotive engine is used.

Great economy in the working expenses, arising from the use of stationary power, and the small amount of deterioration of the works generally.

DAILY EXPENSE OF WORKING A DOUBLE LINE

Of FIFTY MILES long, during a period of 10 hours, with trains starting from each terminus every half hour.

Six Trains always Running.

Coals for five stationary engines, of a 100-horse power each, at 5 lbs. per horse-power—say, 11 tons, at 14*s*. per ton......		£7 14 0
Wages—		
Engine-men, with relief, 10 at 6*s*.	£3 0 0	
Stokers, with relief, 10 at 4*s*......	2 0 0	
Cleaners, with relief, 10 at 2*s*. 6*d*.	1 5 0	
Drivers, with relief, 12 at 5*s*. ...	3 0 0	
Guards, with relief, 12 at 5*s*. ...	3 0 0	
Twenty men, stationed along the line, at 3*s*.	3 0 0	
		15 5 0
Repairs of engines, with depreciation, &c., at £200 each per annum, multiplied by 5 = £1,000—daily proportion..........		2 15 0
Contingencies		4 6 0
Total..		£30 0 0

Forty trains, at 15*s*. per train, £30, being a fraction more than 3½*d*. per train per mile.

Parties desirous of viewing the model, or receiving further information, will be immediately attended to, by addressing Mr. Cunningham, at the Auction Mart Coffee-house, Bartholomew-lane, London; or Mr. Carter, Engineer, Peak-hill, Sydenham.

Gutta Percha.

October 1, 1847.

THE GUTTA PERCHA COMPANY, in requesting the attention of the Public to the accompanying Testimonials, have great pleasure in stating that the steadily increasing demand for the PATENT GUTTA PERCHA DRIVING BANDS justifies the utmost confidence that they are fully approved.

Their durability and strength, permanent contractility and uniformity of substance—their insusceptibility of injury from contact with Oils, Grease, Acids, Alkalies, or Water, and the facility with which the single joint required can be made in Bands of an indefinite length, render them superior

ll working purposes, and decidedly eco-

Haslingden, September 4, 1847.
—We have now been using the Gutta ps for the last eight months, and have ure in saying they have answered our ine expectations; and we may add, that machines which required a 12-inch lea- and which almost daily required to be have been turning the same with the ia Straps 10 inches only for the above- d, and now find them as good as the re first applied.
Ve remain, yours respectfully,

W. & R. TURNER.
tham, Esq., Gutta Percha Company.

las Works, Manchester, Sept. 1, 1847.
eply to your inquiry as to the result of ence with the Gutta Percha Straps, we pleasure in stating that the advantages s are so very manifest as to induce us to i in almost every instance where new equired.—We are, Sir, very respectfully,

SHARP, BROTHERS.
tatham, Esq., Gutta Percha Company.

Bridgewater Foundry, Patricroft, near Manchester, Sept. 3, 1847.
reply to your inquiry respecting how we utta Percha Machine Straps or Driving ough we have not had quite so much in the above-named use of Gutta Percha to have, so far as we have employed it, n us general satisfaction. The beauti- ht and regular manner in which it runs eys, especially on our cone or speed pul- rong recommendation in its favour; and e are inclined to think it does not take ip on the pulley as leather, yet there is for all general purposes. We shall con- e it and to give it our best attention, so how to employ to best advantage the llent qualities it possesses over the ordi- r belts.

NASMYTH, GASKELL, & CO.
m, Esq., Gutta Percha Works, London.

Manchester, 18th June, 1847.
,—We beg to inform you that we have e patent Gutta Percha Bands or Straps nore than six months. For tube frames r them very much superior to anything ried before. They also do very well as for mules, throstles, looms, &c.
, Sir, yours respectfully,

THOS. DODGSHON & NEPHEWS.
uel Statham, Gutta Percha Company.

Wellington Mills, Stockport, 4th September, 1847.
en,—We have much pleasure in bearing ony to the valuable qualities of the Gutta driving bands. We have found it answer y well in most cases where we have tried think it has only to be made known to very general use.
Gentlemen, yours obediently,

IOLE, LINGARD, & CRUTTENDEN.
utta Percha Company, City-road, London.

'ottington Hall, near Bury, Lancashire, September 3, 1847.
;,—Your letter of the 31st August is to l in answer respecting the use of your cha Bands, I cannot give you a better ir approval of them in preference to lea- s, than having given an order for another rtner, yesterday, to be in readiness in case it. They are decidedly preferable to the ; and we can recommend them with the onfidence to any person for Driving Straps.

ALL & GORTON, THOMAS GORTON.
am, Esq., Gutta Percha Company.

Brewery, 16th September, 1847.
Gentlemen,—We have much pleasure in repeating our testimony to the very great improvement effected by the use of Machinery Bands made of your material instead of leather: the stoppage of parts of our works, through the failing of the leather straps, used to be of daily occurrence, causing great inconvenience and expense. With this annoyance we are now never troubled, and are assured by our superintendent that the advantage of using your material is surprising, as regards economy and saving of trouble. We confidently recommend it to machinists and factories for general adoption.

TRUMAN, HANBURY, BUXTON, & CO.
To the Gutta Percha Company.

Patent Gutta Percha Soles for Boots and Shoes.

The capabilities of the GUTTA PERCHA SOLES FOR BOOTS AND SHOES having been extensively and satisfactorily tested, we can unhesitatingly recommend the material prepared for the purpose, its merit having been acknowledged by all who have worn it. Indeed, experience has proved that Gutta Percha Soles wear twice as long as leather, with great additional personal comfort, and they remain perfectly impervious to wet until quite worn through.

23, Southampton Row, 1st Sept., 1847.
Gentlemen,—I write to thank you for allowing me to use the new PATENT GUTTA PERCHA SOLES. I felt annoyed at not being allowed to use them from the time I had first worn them, namely, from last October, but am not sorry now, because I can speak confidently of their advantages over leather soles. I made the first pair last October, and wore them eight months before I wore the soles through. I had them heeled six times, and one pair of extra fronts I put to the same soles. *I only kept the one pair in wear to see how long they would last.* I will never wear another leather sole so long as I can get GUTTA PERCHA SOLES, and I walk from 12 to 20 miles a day.

C. WRIGHT, Boot and Shoe-maker.
To the Gutta Percha Company.

9, Gloucester Row, Hoxton, 5th July, 1847.
Sir,—I beg to thank you for the boots with GUTTA PERCHA SOLES which I had from you on the first of the year. I have had them in constant use for nearly five months, the greater portion of that time being the most inclement period of the year; and from my occupation as a general post letter-carrier, you may be sure that they have had more than a common fair trial, and the Gutta Percha seems now as firm and as little worn as on the first day. W. HUTTON, G. P. O. Letter Carrier.
To E. Granville, Esq., Gutta Percha Works.

28, St. John-street, August 25th, 1847.
Gentlemen,—It gives me great pleasure to acquaint you that the Gutta Percha Soles I had from your Works have answered the purpose admirably, as I can fully testify, having had them in wear six months, during the winter, in Smithfield-market, and have not been subjected to the annoyance of wet feet, as is often the case with leather soles, and, in my opinion, they wear three times as long.

H. I. TARLING.
To the Gutta Percha Company.

N.B.—The above Soles, which are not worn out, may be seen at the Gutta Percha Company's works.

Galoshes, Tubing of all sizes, Bougies, Catheters, and other SURGICAL INSTRUMENTS; MOULDINGS FOR PICTURE-FRAMES and other decorative purposes; WHIPS and THONGS, TENNIS, GOLF, and CRICKET BALLS, are in a forward state of manufacture, and will be very shortly ready for sale.

All orders forwarded to the COMPANY'S WORKS, WHARF-ROAD, CITY-ROAD, will receive immediate attention.

Professor Davies's "Law of Atmospheric Resistance." *Errata.*—Page 410, col. 2, line 17, for *v* read *x*; line 38, for *its* read *the*.

CONTENTS OF THIS NUMBER.

LONDON: Edited, Printed, and Published, by Joseph Clinton Robertson, of No. 165, Fleet-street, in the City of London.—Sold by A. and W. Galignani, Rue Vivienne, Paris; Machin and Co., Dublin; W. C. Campbell and Co., Hamburgh

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MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

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Edited by J. C. Robertson, 166 Fleet-street.

SIMPSON'S SUBMERGED HORIZONTAL SIDE-PROPELLERS.

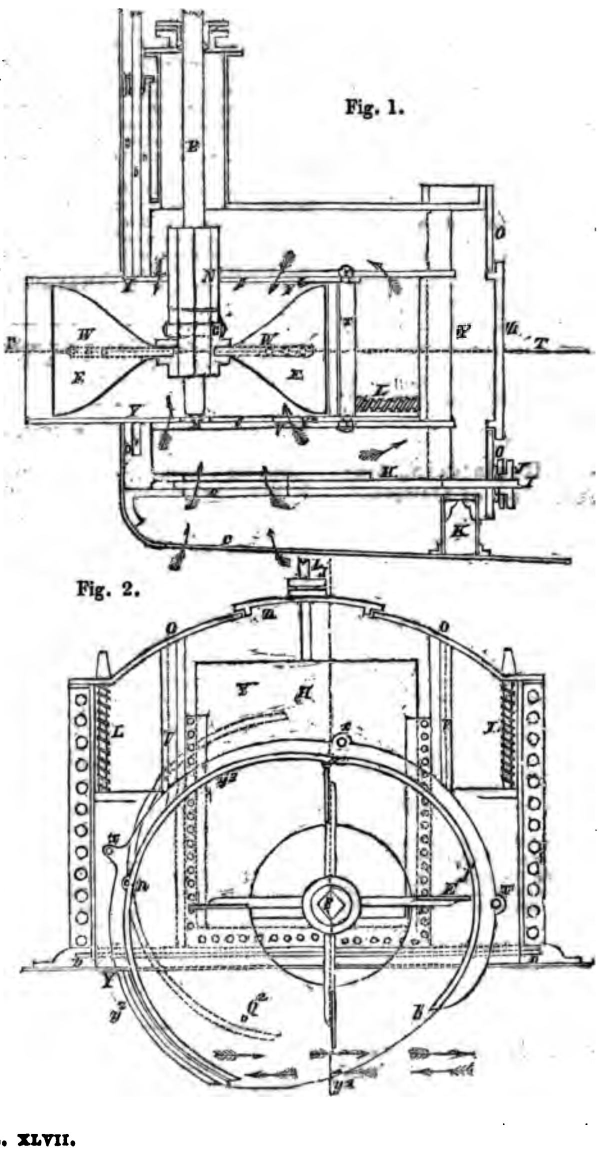

Fig. 1.

Fig. 2.

SIMPSON'S SUBMERGED HORIZONTAL SIDE-PROPELLERS.

[Patent dated September 25, 1846. Specification enrolled March 25, 1847.]

On Saturday last a small steamboat, called the *Albion*, fitted with invisible, or submerged horizontal side-propellers, on the plan patented by Mr. T. B. Simpson, made her first experimental trip down the river. The boat is 90 feet long, and of 10 feet beam; the engines are of 10-horse power, and built by Messrs. Christie, Adams, and Co.

Several plans of horizontal side-propelling have been before proposed; one by the present patentee himself in connection with another party, which was described in our 43rd vol., p. 433. The one now before us is distinguished from its predecessors in three important particulars. *First*, The wheel-case is made of such a shape and construction, and the paddles are set in such a position, that as the wheel revolves it produces a strong current of water directly sternwards, or in a direction parallel to the line of the vessel's course. Something like this has been done by submerged propellers before, but not, we think, to the same extent. The result is a combination of two forces to propel the vessel — the direct leverage of the paddles, and the retro-active thrust of the sternward current. *Second*, The paddles are so fixed that they may be protruded more or less beyond the side of the vessel, or be brought flush therewith. And, *Third*, the case is made moveable, and provided with such appliances that both case and wheel may be shut up entirely from the water when they are not required to be in use, or when it is desired to obtain access to them from the inside of the vessel for purposes of inspection or repair.

We apprehend that the inventor aims less at obtaining a high degree of speed, by his arrangements, than at enabling steam power to be applied to vessels under circumstances where large and permanently projecting paddle-wheels and cases are insurmountable objections; as, for example, in narrow rivers or canals, or where the power is required only for occasional use, as in ocean merchantmen. We infer so much from the form given to this experimental vessel, the lines of which are as little calculated for speed as any we ever saw; but perhaps that may have been an accidental fault of construction.

The distance between the Brunswick-pier Blackwall, and Erith, stated to be 12½ miles, was performed on this experimental trip in 1 hour, 11 minutes. Not a great speed this, contrasted with that of a paddle-wheel vessel (the *Courier*), whose trial-performances are recorded in our present Number; but still a degree of speed highly satisfactory, if considered in combination with the other advantages with which it is accompanied, and which are peculiar to this mode of construction. Not the slightest surface-swell was perceptible; neither was there any of that vibration on board which is felt more or less in all other steam-propelled vessels.

We extract the following descriptive particulars, and also the illustrative figures prefixed, from Mr. Simpson's specification:

Fig. 1 is a sectional elevation, and fig. 2 a sectional plan on the lines, TT, of one of a pair of wheels, formed, constructed, placed, and fitted, according to the said plan. K, is a strong basement of metal or wood, secured to the bottom of the vessel. Y, is a recess made in the side of the vessel, which is partitioned off on the inside by a casing of wood or metal, Y^3, from the rest of the hull, but is open to the water in front between *a* and *b*, and has also an opening, *c*, to the water at the bottom. Y^2 is a case of metal, supported on ribs, VV, thrown athwart the bottom opening, *c*, which immediately incloses the wheel, W, and is of an area considerably less than the recess: it consists of a fixed bottom and top, connected by vertical posts, *xxx*, and divided on the sides or periphery, into four parts or segments, y^1, y^2, y^3, y^4, of which y^1 and y^2 are solid pieces united to the top and bottom parts of the case, y^3 is a moveable piece turning on a pin at *n*, and y^4 is wholly open to the water in front. The moveable piece, y^3, fits at one end within the fixed piece, y^2, and overlaps at the other end one end of the fixed piece, y^1; but it may be moved out of these positions to the extent indicated by the dotted lines, when it serves, as afterwards explained, the purpose of a valve to the case. Q^2 is a stop raised on the bottom of the case, which prevents the moveable piece, y^3, frommoving so far round as to interfere with the leaves or floats, E E. The top and bottom of the case have central openings, *e* and *f*, leading into the interior of the wheel, the former, *e*, corresponding with

ttom opening, *c*, of the recess. The
f the wheel is stepped at bottom in a
piece, M, secured to the bottom of the
case, (in the reverse direction of the
V,) and connected at top to the driving
3 (which passes through a stuffing-box,
means of a coupling-box, N, and
. The wheel-case has two horizontal
, LL, attached to the back of it, and
l from within the vessel, by means of
it may be moved forwards or back-
on its supporting ribs, VV, and the
may be also moved along with it,
uncoupled for the time from the
g-shaft, B). The wheel and case may
truded to any extent not exceeding
eatest diameter of the case, and to
ver extent within such limit they are
ided the case must fit exactly the
pening of the recess, (as exemplified
s. 1 and 2.) The greater size of the
admits of both the wheel and case being
withdrawn within the recess. Pre-
to setting the wheel to work, the recess
heel-case are entirely filled with water
h the front top and bottom openings,
motion being given to the wheel (say
right to left) the water is driven
y the centrifugal action of the
or floats, EE, through the front
gs in the recess and wheel-case, while
inuous supply of other water to the
r of the wheel is kept up, by the in
rough the top and bottom openings,
, as indicated by the arrows. But as
esirable that the water should be driven
a direction more sternward than could
cted by the centrifugal action of the
or floats alone, this is accomplished
king the forward part, y^4, of the wheel-
roject beyond the side of the vessel to
h greater extent than the hinder-part,
s shown in fig. 2?) which causes a forci-
t gradual deflection of the water in the
d direction. And in order that there
t the same time be an open and free
for the ejected water, the wheel-case
re or less enlarged forward. In fig. 2
nlargement is exemplified as carried
o the largest extent which I should
advisable; but I do not limit myself
r particular degree of enlargement, as
ould necessarily vary with the dimen-
form, and position of the leaves or
employed. And the more effectually to
a free egress for the water, the leaves
ats may be made to turn on their edges
passing round the back part of the
which may be effected by any of the
ved and well-known methods of causing
e-wheel floats to feather or turn on

ien it is desired to back the ves-
this is done in the usual way, by
reversing the motion of the driving-shaft; but it being expedient in that case to diminish the open space forward in the wheel-case, and to prevent any inflow of water from the outside at the forward end, this is effected by means of the moveable or valvular piece, y^3, before mentioned. The current of water, as long as it is flowing in the direction of the arrows, presses the outer end of the piece, y^3, up against and flush with the inside of the part y^2, of the wheel-case; but immediately on the current being reversed, it turns the piece, y^3, into the position indicated by the dotted lines. When it is desired to suspend for a time the employment of the wheels—as, for example, when they are employed as auxiliaries merely, and recourse is had to the sails alone, or when it is desired to get conveniently at the wheels for the purpose of inspection or repair—the cases and wheels may be drawn back within the recesses by the screws, LL, as before mentioned (the wheel-shaft being uncoupled for the time from the driving-shaft,) and wholly shut off from the water, and thrown open to access from the inside of the vessel by means of the following additional arrangements:—D, is a vertical piece of metal, which is let into the side of the vessel immediately above the wheel-recess, and D^a, a slide, which fits into a groove made in this metal-piece, and is raised or lowered by means of a chain weight, and pulley (not shown in the figuress,) or any other suitable means. On the withdrawal, as aforesaid, of the wheel-case and wheel, and dropping the slide, D^a, it falls into a corresponding groove made for its reception in another metal-piece, D^2, fitted into the side of the vessel immediately beneath the wheel recess, and that recess is thereby closed against the water in front. The bottom opening is closed in like manner by means of a horizontal slide, H, which moves in an opening made for it in the bottom casing of the wheel recess, and is pushed forward or drawn back by means of a screw-shaft, I, acted upon from within the vessel, which passes through a stuffing-box, J. When the wheel recess has been thus closed in by the two slides, D^a and H, the water may be pumped out of it, or run into the bilge, and a water-tight door, Z, formed in the back part, OO, of the recess, may be then opened to give admission from the inside of the vessel.

R, is an air-vent tube, with a stop-cock or valve, which may be carried to any height, or in any direction found most convenient.

Mr. Simpson has deviated somewhat from the plan thus set forth in his specification in the construction of the *Albion*, but the extent to which he has done so

we must reserve for explanation in our next.

ON THE EMPLOYMENT OF HEAT AS A MOTIVE POWER. BY A. H.

(Continued from page 405.)

The rationale of the facts of specific and latent heat is the same; in both the same mechanical law is involved. The non-communication of motion to the mercury in the one, and the different degrees of such communication, according to the substance with which it is in contact, in the other, are of the same nature as the difference between the specific heat of a gas under constant pressure and constant volume; the reason of which has already been given. All of these various effects are but instances of the general mechanical fact, that in a machine composed of different parts, or indeed in any compound system of particles whatever, if one portion of the machine or system be free to move in obedience to the moving force, it will absorb in so doing, that which would have been communicated to other, portions if it had been fixed. With regard to the specific heat of different bodies, that is, the different degrees of dilatation of the mercury in contact with them, when a given amount of heat is supplied, the cause of this lies in the different degrees of resistance between the contiguous particles of the substance. The greater the resistance, of course the greater the re-action against the mercury, and consequently the greater the expansion of that mercury. If the particles of the substance experimented on be ready to yield easily,—that is, if the mutual cohesive force be small, the motive power of the heat is employed in *dilating* the substance, and therefore there is the less of it for the mercury; whereas if the molecular resistance of the substance were greater, there would be a proportionally greater amount of pressure or re-action against the mercury available for producing motion or expansion in it. It is for this reason that in the last paper I said, that, probably the specific heats of all substances are the same if sufficient external pressure be exerted to keep them under a constant volume, *i. e.*, to prevent their expanding.

Now with regard to latent heat, the same reasoning is obviously applicable. *The resistance to* expansion in the particles of the water in which the thermometer is immersed, becomes less and less, and therefore there is a continually diminishing re-action against the mercury. But through a considerable range of temperature this diminution is very gradual and small: when, however, the point of ebullition is approached, this resistance, and the consequent pressure against the mercury diminishes with extreme rapidity, and at length disappears altogether, leaving the thermometer stationary.

Let us now return to the subject of specific heat, for the purpose of examining the various circumstances affecting it. It will be observed that Dulong and Petit's Table contains only what are called "simple or elementary substances." As the very name implies, therefore, we have in such substances no indication of any other effect being produced by the heat besides the expansion of the substance: I mean we have no *chemical action*, no resolution of compound particles into simpler ones, nor any appreciable tendency towards such an effect. If now we go on to experiment upon those substances which we know to consist of compound particles, our reasoning must be qualified accordingly. The *tendency* to chemical decomposition must be taken account of, and measured in the same way as the tendency of water to pass into steam: there will be a latent heat from the one as well as from the other cause. Take, for instance, the oxide of a metal, MO; not only will the heat be employed in separating one particle of the *oxide*, MO, from another particle of the same kind, but also in separating the M in any one compound particle from the O in that same particle. We cannot therefore compare *directly* the work done in two such different cases as those of a simple and more compound substance. The ratio of the specific heats will not therefore necessarily follow the same law as those of *similarly* constituted bodies. The specific heat, for example, of oxide of copper will not bear to that of a simple substance, such as iron, the inverse ratio of their atomic weights. But if we take two compound bodies of similar atomic constitution, then there is more probability of *their* specific heat, being inversely as *their* atomic weights. This is precisely the characteristic law of the recent experiments of Regnault. His researches have been extended to a very

variety of bodies—the results may und tabulated in Pouillet's *Ele- de Physique*, fourth edition, tome . 511—517. So far as the sim- odies are concerned, these recent are confirmatory of those obtained long and Petit. To give an idea results, I shall copy a few:

product of the specific heat by mic weight for the same class of nces as those comprised in Dulong 'etit's Table, averages about the r 40, the least being 37.849, and ghest .42.7. (Bismuth, however, is .) The same product for the pro- s (MO) of lead, mercury, manga- nickel, copper, averages 72.03., vest being 70.01, and the highest Similarly for the sulphurets of nickel, cobalt, zinc, lead, mercury, n, the product varies from .71.34 34. But for the basic oxides e formula is M_2O_3) this number from 158.56 to 180., and similarly e similarly constituted sulphurets For the substance of the form (chlorurets of sodium, potassium, ry, copper, and silver) the number from 156.97 to 163.42. For the tes ($MO+SO_3$) of barytes, stron- ead, magnesia, lime, the product from 164.01 to 168.49. For the ates ($MO+CO_2$) this number va- m 131.61 to 138.16. The more x chemical substances give still numbers: the nitrates (NO_5+ give 301.72. Arseniate of lead $+3\ P_6O$ gives 409.37. The law ng from these experiments is thus nced by M. Regnault himself: s tous les corps composés de même sition atomique et de constitution ue semblable, les chaleurs spéci- sont en raison inverse des poids ues."

Before proceeding to the consideration of these more complicated cases, it will be as well to state more fully the reasons for assuming, in my last paper, that

$$\frac{r'-r}{s'-s}=\frac{B}{A}.$$

(The reader will have noticed a slight misprint of this equation in the last paper.)

The substance (n) and the mercury in the thermometer, being equally exposed to the action of the quantity of heat, C, the pressure resulting from this, and which produces the increment of molecular distance $(p'-p)$ in the mercury, and $(r'-r)$ in the substance (n) will necessarily be the same for both. Denote it by P. Then we have the dilatation $(p'-p)$ produced by the pressure, P, acting in opposition to the resistance, R, and it is at least "highly probable" that this dilatation is directly proportional to the former force, and inversely proportional to the latter, so that $(p'-p)$ is proportional to $\frac{P}{R}$. (We know that in elastic strings the increase of length is, *cæteris paribus*, proportional to the weight or pressure which stretches the string.) Similarly $(r'-r)$ is proportional to $\frac{P}{A}$. Therefore $\frac{r'-r}{p'-p}$ is proportional to $\frac{R}{A}$. Similarly $\frac{s'-s}{p'-p}$ is proportional to $\frac{R}{B}$; whence, lastly,

$$\frac{r'-r}{s'-s} \text{ is proportional to } \frac{B}{A}.$$

If we take $\frac{r'-r}{p'-p}=\frac{R}{A}$, then the ratio of the specific heats of the two substances will be given by the equation

$$\frac{\text{Specific heat of substance } (m)}{\text{Specific heat of substance } (n)}=\frac{mB\,(s'-s)+N.R\,(p'-p)}{nA\,(r'-r)+N.R\,(p'-p}$$

$$=\frac{mB\,(s'-s)\left[1+\frac{N}{m}\right]}{nA\,(r'-r)\left[1+\frac{N}{n}\right]}=\frac{m\left(1+\frac{N}{m}\right)}{n\left(1+\frac{N}{n}\right)}.$$

g the number of particles in mer- and (m) and (n), those in the two nces whose masses are supposed to r great compared with that of the mercury. The two fractions $\frac{N}{m}$ and $\frac{N}{n}$ are each very small quantities; in fact, they are the same as the following fractions.

$$\frac{\text{weight of mercury in thermometer}}{\text{weight of substance operated on}}\times\frac{\text{atomic weight of substance}}{\text{atomic weight of mercury}}.$$

and are not only small from the small quantity of mercury used, but also from the atomic weight of mercury being so much greater than of most other bodies.

If we now endeavour to apply the same reasoning to the case of compound particles where there is a tendency to, and may be an actual occurrence of, chemical decomposition, we shall see at once how variations from the law would arise, if the comparison be made between the specific heat of substances of *different orders* of molecular complexity. Take, for example, an oxide, whose particles each consist of the two simpler molecules, M and O. Between one of these *compound* particles and the next let the mean resistance to expansion be denoted by A_1, and dilatation by dr_1. And between the molecule, M, in any one of these compound particles and the other molecule, O, in the same particle, let the resistance be denoted by A_2, and dilatation by dr_2. Then, as before, we should have

$$C = N.R\,(p'-p) + nA_1\,.dr_1 + n.A_2\,dr_2.$$
$$\text{Similarly } C' = N.R.\,(p'-p) + mB_1\,ds_1 + mB_2\,ds_2.$$

What relations, however, can be assumed, with any degree of safety, between A_1, dr_1, A_2, dr_2, &c., it is not easy to see. A_1 and A_2 belong to *different orders* of forces—the one producing simply an expansion between two compound particles, and the other separations of the simpler or "ultimate" constituents of the compound particle. The latter force, in general parlance, would be termed a chemical force, as being of a different kind from the former, which would be called a "cohesive" force, or some such name. The difference, however, can only consist in different degrees of energy and different laws of variation, according to the distance. All the phenomena of nature are but the manifestations of different orders of forces, each order producing its own class of facts, and the different orders not interfering at all with each other's peculiar effects. Thus the force of "gravitation" affects the larger masses without interfering with the effect of heat in dilating the minuter particles, or with a still different order of forces whose action is on still smaller molecules. And as we, in our limited experience, are able to observe but a few of these different orders, it is probable that the series may extend far beyond anything of which our senses can inform us, and gravitation itself may be to other forces what "chemical" attractions are to it. Our solar or sidereal system may be moving in accordance with some different order of force to that of gravitation, just as our planet is moving in obedience to a different order from that which produces what we term chemical decomposition. And still further we may rationally conclude that all these different orders of force are bound up in one general law; or, to use the language of mathematics, which will convey perhaps more clearly the meaning intended, we may say that, as we express all the facts of gravitation by one formula, if our knowledge were sufficient to enable us to express all the facts of heat, chemical action, &c., by other such formula,—and if still further we had cognizance of facts beyond the greatest and least limits of our present observation, and knew the law of force governing the motion of those minuter molecules to which even chemistry does not reach, and on the verge of creation could attain similar knowledge as to the law of force by which our solar system is governed and moves like an atom with regard to a still higher system, and that again in its turn as portion of a yet higher—all these single and individual formulæ would no doubt be comprised in one primary formula, the knowledge of which would just as certainly and easily lead to the foreseeing and explaining of all the phenomena of the universe as the formula

$$f = \frac{\mu}{r} \text{ leads to the prediction and}$$

explanation of all the motions of our planetary system.

The reader must excuse this digression—and as "from the sublime to the ridiculous there is but a step," he will probably be thinking that this "formula" must be that "equation finalé" of the Frenchman mentioned by Robison, in his article on "Corpuscular Action," which equation expresses "touts les faits possibles." Considerations of this sort come almost inevitably to those whose attention is at all directed to such subjects; and, indeed, since writing the pre-

g remarks, the following passage in .me article of Robison's has caught re, which I do not recollect having before: "The modifications of cohe- re innumerable, producing an end- ariety of sensible forms, solid, fluid, ous, in each of which the law of ac- etween the corpuscles is probably ent. Also, in each of these forms we subordinate varieties, which makes hard, soft, elastic, unelastic, , ductile, viscid; and, lastly, there her modifications of the corpuscu- rce which produce the phenomena ution, precipitation, crystallization, &c. All and each of these are ately mechanical forces, producing motion and changes of motion. In ange of observation there are two mes. On the one hand, enlarging cale, we have electricity, magnet- nd gravitation. This last leads us bounds of the solar system: nay, are appearances which render it ble that it extends at least to some e fixed stars. But we have not ent authority for extending it to Gravitation may cease at a certain ce; nay, it may change to a repul- orce at greater distances, and the universe may consist of parcels are in equilibrio with one another, particles of a common body are uilibrio between a state of attrac- d repulsion. Each parcel of con- stars, magnificent as it is in our nay thus constitute a portion or e of the universe: our imagina- are lost in the contemplation of scene. But there is no absurdity thought. The ingenious Dr. proved, from the law of gravita- hat there may be *within* this globe e of existence and habitation alto- undisturbed by the gravitation of al bodies, yet everything having and stability nearly the same as surface of the earth. To its in- nts the scene may appear as ex- as the heavens appear to us." . *Philos.*, vol. i., p. 260, &c.)

needless to make any observations value to the chemist of such laws se connecting the atomic weights he specific heats. One remark will add. Both from theoretical erations on the manner in which eater or less complexity of the cal composition of a body will affect its specific heat, and from the experimental results of M. Regnault, it is clear, that if we obtain by experimenting on two substances specific heats, such as to verify the law of inverse proportionality to the atomic weight, we may safely conclude a similarity of chemical composition, such, for instance, as might serve to decide whether a substance entered into a combination as a protoxide, or deutoxide, as a nitrate, or basic nitrate, &c. In organic chemistry, especially, the value of such a guide would be very great in all questions relating to "compound radicals," or "proximate elements"—the whole subject being a question as to the *different orders* of chemical forces—on which, as we have seen, the specific heat depends. So that, if one "compound radical" takes the place, or is capable of being substituted for another substance in any combination, the two may be said to be of the same order of force, and be expected to affect the specific heat of any combination in which they enter in the same way.

It has often occurred to me that many of the peculiar relations between oil and water, and other such dissimilar substances, are owing to the difference of magnitude between their ultimate particles. The particle of water, for instance, is HO, whose atomic weight is 9. A particle of oil of turpentine is represented (according to Gregory, "Organic Chemistry,") by $C_{10}H_8$, or $C_{20}H_{16}$, and therefore its atomic weight must be 68° or 136°. The disproportion is enormous, and if chemical analysis can be relied upon, in some other of the oils it is very much greater than even this.

How far this consideration is available in explaining Franklin's experiment I shall leave the reader to try, not having been able to obtain any distinct mechanical view of it myself: all that I can understand being merely this, that the motion communicated by the agitated water to the lower strata of the superjacent oil is, somehow or other, rapidly enfeebled and prevented from reaching the upper strata. In the case of only one medium, as for instance, the waves of the sea, there appears to be a similar effect, the agitation of the surface being only propagated to comparatively small depths. This fact I

believe has been found by experiment: namely, that at a certain number of feet below the surface of the ocean there is no perceptible disturbance caused by even the greatest waves on the surface. Lagrange takes notice of this fact in his investigation of the velocity of propagation of waves, and attributes it to the adherence or viscidity of the particles of water:

"Au reste, quelle que puisse être la profondeur de l'eau, et la figure de son fond, on pourra toujours employer la théorie précédente," (in which the whole depends on supposing the depressions and elevations very small compared to the other quantities which enter the problem); "si on suppose que dans la formation des ondes l'eau n'est ébranlée et remuée qu'à une profondeur très-petite, supposition qui est très plausible en elle-même, à cause de la tenacité et de l'adherence mutuelle des particles de l'eau, et que je trouve d'ailleurs confirmée par l'experience, même à l'égard des grandes ondes de la mer." (Mecanique Analytique, tom. ii., p. 335).

With regard to Franklin's experiment, I may add, that the fact evidenced in it has been long known to whalers, namely, the calmness of surface produced when large quantities of the whale oil are spread over the surface of the sea.

The consideration of the relative masses of the constituent particles of substances, (oil and water, for instance,) as influencing their mutual solvent and chemical action, leads to some interesting speculations. It is a general law, for example, that similarly constituted substances are the best solvents of each other:

"Avez-vous des métaux à dissoudre; pour cela prenez d'autres métaux; le mercure par exemple conviendra le plus souvent. Sont-ce des corps très oxidés, recourez en general aux dissolvans très oxidés; des corps très hydrogénés ce sont ordinairement des dissolvans très hydrogénés que vous devrez choisir. Une huile dissout facilement une graisse, une resine; eh bien! consulter la composition de ces corps, elle est toute semblable." (Dumas' Leçons de Philosophie Chimique, p. 391.)

Those who are disposed to indulge in such speculations will find materials in the work just cited—and as the author is one of the greatest chemists living, *his* speculations are not likely to be without solid support from experimental observation. There is also a curious note, referring in some degree to this question of the influence of the relative proportions of particles, in Boutigny's work, from which so many extracts have already been made. (P. 183, 4).

In the next paper, I intend to go into the question relating to Vaporisation and Evaporation, a subject involving, as one part, the question as to the relation between the pressure, temperature, and density of steam.

Note.

In Problem I, I have denoted the whole increment of pressure in a gas prevented from dilating, by Pk, and added this to the work done in expanding the mercury. I question whether there is any more reason for doing this than there would be, in estimating the work done by a steam-engine, for adding in the pressure sustained by the crank-axle, or any other fixed part of the machinery, by means of which the force is transmitted. Therefore it appears to me that the following is the more correct way of treating this question. Let, as before, the quantity of heat, C, raise the mercury in contact with the expanding gas through one degree, or increase the distance of its particles by $(r'-r)$. And let C′ be the quantity of heat required to raise the mercury through the same space when the gas is confined to a constant volume. Then

$$C = Ph + nR(r'-r) \dots\dots\dots \text{Pressure constant.}$$
$$C' = \quad nR(r'-r) \dots\dots\dots \text{Volume constant.}$$

$$\therefore \frac{\text{Specific heat (pressure constant)}}{\text{Specific heat (volume constant)}} = \frac{C}{C'} = 1 + \frac{Ph}{nR(r'-r)},$$

the value given by experiment for common air is $1 + \frac{417}{1000}$ by some experimenters, and rather differently by others. If we take it to be about $\frac{2}{5}$, then $\frac{Ph}{nR(r'-r)} = \frac{2}{5}$. Now in any experiment (h) is known and also P, (which will vary with the volume of gas operated on, as well as on other circumstances,) there seems to be here, therefore, a method of obtaining a relation between the mean resistance of mercury to expansion through one degree (which however is itself variable towards the extremes of the scale) and the increment of molecular distance $(r'-r.)$

From the first of the preceding equations,

also, it is obvious that, other things being the same, the specific heat of a gas is less the smaller P is, *i. e.* the less the pressure it is subjected to. This is one of the results announced by M. M. Delarive and Marcet, from their experiments. Their other experimental law has been noticed already in the last paper. A. H.

CHAPTERS ON ANALYTICAL GEOMETRY. BY JAMES COCKLE, ESQ., M.A., BARRISTER-AT-LAW.

(Continued from page 434.)

CHAP. VIII.—*On the Hyperboloid of Two Sheets.*

SECTION 1.—*Propositions.* By the aid of the following theorems we shall be able to recognise the equation to the hyperboloid of two sheets. Part of their enunciation is analogous to that of the propositions which I gave for distinguishing the equation to the ellipsoid,* but with an improvement of form.

I. *When a surface of the second degree can be met* in a point *by* [only†] *two planes parallel to, and at a finite distance from, one another; then—provided that planes drawn parallel and* exterior *to the former ones meet the surface—the surface is the* hyperboloid of two sheets.

II. *When a surface of the second degree is met* in a point or a straight line, NEITHER *by any of the coordinate planes* NOR *by any planes* whatever *drawn parallel to* any *of the coordinate planes, the surface is the* hyperboloid of two sheets.

III. *The hyperboloid of two sheets possesses the following property:*

It can EITHER *be met* in a point *by* [only†] *two planes parallel to a coordinate plane and at a finite distance from one another; in which case planes drawn parallel and* exterior *to those planes meet the* hyperboloid:

OR, *none of the coordinate planes, nor any plane* whatever *drawn parallel to any of the coordinate planes, can meet the hyperboloid either in a point or a straight line.*

SECTION 2.—*Examples.*

(*Ex.* 3.) What surface is represented by the equation

$$2x^2+5yz+3z^2+2yz-4zx-2xy=11\ ?$$

[Hymers, p. 149.]

Proceed as follows:

x^2	yx	zx	y^2	zy	z^2	1
2	-2	-4	5.	2	3	-11
·	·	·	$\times 2$	·	·	·
2^2	$-2.2.$	-4.2	10	4	6	-22
			1	4	4	
			3^2		2	-22
					·	·
					2^2	-44

The above process shows that the given equation may be reduced to the form

$$u^2+v^2+w^2-n^2=0.$$

Hence the surface to which it belongs has *not* the property described in Proposition III., and is not, consequently, the *hyperboloid of two sheets.** Dr. Hymers appears to have fallen into error in treating this example.

(*Ex.* 4.) What surface is represented by†

$$yz+zx+xy-x-2y-3z+2-a=0\ ?$$

This equation is equivalent to

$$(x+r)\times(y+s)+\phi(z)=0\ldots\ [\text{A}]$$

where, $r=z-2$,

$$s=z-1, \text{ and } \phi(z)=-z^2-a\,;$$

and [A] can only represent a point or a straight line when

$$\phi(z)=-z^2-a=0,$$

$$\text{or, } z\pm\sqrt{-a}$$

an unreal value of z: in other words, the surface cannot be met in a point or a straight line by any plane parallel to that of xy, nor is it so met by the plane xy. The same thing is true of the other coordinate planes as a similar process will readily show us. Hence, by Proposition II., the surface is the hyperboloid of two sheets (double or point-hyperboloid.)

SECTION 3. *General Remarks.* If a coordinate plane be parallel to a tangent to the ASYMPTOTIC CONE of the hyperboloid of two sheets, the "two planes" mention-

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* *Supra*, pages 360, 361.

† This word "only" serves to distinguish the hyperboloid of two sheets from the single straight line to which the proposition would otherwise apply. The straight line is not however in strictness a *surface*, although it may not always be able at first sight to distinguish its equation from that of a surface, the term "plane parallel to a coordinate plane." In the coordinate plane itself is meant to be included.

* The surface is in fact an ellipsoid; (*Vide supra*, page 360, and compare with the investigation in the text). Dr. Hymers has assigned the equation in s erroneously. That equation should be

$$s^3-10s^2+25s-9=0,$$

in which there are three changes of sign—the indication of an ellipsoid.

† *See* Leroy, p. 160, No. 242. The case of the hyperboloid of one sheet is alluded to in the concluding paragraph of that article.

ed in Prop. I. coincide and the point in which the hyperboloid is met by the resulting single plane lies at an infinite distance. This is a critical case. In the critical case of the elliptic paraboloid there are *two* infinitely distant points of contact. Let a plane be drawn through the centre of the surface parallel to a coordinate plane; then, (1), if the plane so drawn meet the ASYMPTOTIC CONE in a point, the hyperboloid can be met in a point by two planes parallel to this plane; (2) if the plane meet the cone in a single straight line, we have the critical case just mentioned; (3) if the plane meet the cone in two straight lines, the hyperboloid cannot be met in a point by any plane parallel to the plane in question.

Great Oakley, near Harwich, Essex,
October 30, 1847.

Postscript. The following corrections are required in my last *Chapter*:

Supra, page 433, line 28, *for* — *read* +; page 434, line 3, *for* $(3y-3x^2)$ *read* $(3y-3x)^2$

NECESSITY OF INQUIRY INTO THE STATE OF THE DIFFERENT BRANCHES OF OUR NATIONAL INDUSTRY.

Sir,—There is probably no country in the world where inventors labour under greater disadvantages than they do in England. There is by no means a deficiency of mechanical genius in the country, but it is unquestionably a misfortune to probably ninety-nine out of every hundred, that ever the goddess of genius smiled benignantly upon them.

Inventors, no doubt, have their lucid intervals, and enjoy a pleasure peculiar to themselves, and which cannot be comprehended by those whose minds have never been sublimed in the crucible of mechanical and experimental science.

If inventors were not too frequently a pennyless set of unfortunates, of which the writer (at all events in this respect) is an eminent type, they would enjoy a full average of the bliss of mortals.

An inventor in tolerably easy circumstances, who can handle his tools, and command some portion of his time, may be classed among the most fortunate of the race; and notwithstanding the many rebuffs he may meet with from those to whom he might naturally look for some encouragement, still it is not intended to pen a jeremiad on behalf of unfortunate inventors, but simply to make a few suggestions, which, if adopted, would benefit those who are in possession of substantial projects, but unable for want of funds to bring them forward—who are, therefore, doomed to endure the pangs of disappointed ambition, for it is presumable that their pursuits are as worthy of the name of ambition as the pursuits of the warrior who carries devastation in his train. The country is also deprived of the advantage of many highly important improvements which it might, and which it ought to possess.

I am not, however, going to be guilty of the extreme folly of supposing that the Government either will, or ought to do anything in the matter, or indeed, any board or department under the immediate control of Government. It would be cruel to afflict inventors with a nightmare of this description.

I would therefore suggest that a committee be formed, consisting of the most scientific and practical engineers, directors, and others connected with each department of mechanical, manufacturing, or scientific undertaking, and that these committees should investigate all such matters connected with their several departments, as might be submitted to them by inventors or others.

The constitution of these committees would be such, that inventors in many cases would be disposed to submit their projects to them before incurring the various preliminary expenses which they now frequently incur, and can in many cases but ill afford.

But, to particularize—take first the railway interest; the general committee in this case would consist of civil and mechanical engineers, and railway managers; and projects brought under the notice of this committee would be referred to a sub-committee of those best qualified to form a correct opinion upon the particular subject referred to them. Suppose such a committee had been in existence previously to the construction of many of the existing railway bridges, and that this committee had had funds placed at its disposal to institute a well-directed set of experiments, (the expense to be borne by the whole railway interest,) no such structure as the Dee bridge, or any of that *negative-truss-bar* class would have been in existence.

At present, a committee of this de-

scription could very advantageously investigate the subject of sailway signals, the application of breaks, position of points leading into sidings, and all such matters as relate to the safety of railway travelling.

By this means one most important object would be attained, that is, uniformity of practice in the various manipulations of railway management, so that the engine-drivers and other parties changing from one railway company to another, would not be led into mistakes (resulting in fearful accidents,) caused by different arrangements upon railways under different management.

Matters of prudential economy might not be altogether out of the question in the present aspect of railway affairs, and the investigation of cheaper modes of conveying passengers and goods than those at present in operation.

Then, secondly, take the mining interest in connection with the various plans proposed for raising water. How soon would a committee of competent persons connected with that important undertaking, empowered to make substantial experiments, decide the fate of the spray-pump, either one way or the other? The published statements at present respecting this invention are so contradictory as to baffle every attempt at forming even an approximate opinion of its merits.

The various coal-works subject to inflammable or noxious gases, would, no doubt, be much benefited by frequent consultations of the best-informed parties connected with these undertakings. When accidents take place, the proposed committees in this, as in other cases, might assist with their collective knowledge of the subject in endeavouring to discover the cause of an accident, with the view to the adoption of the most efficient means to prevent the recurrence of future calamities. By this means responsibility would rest where it ought to rest, the parties concerned would be considered completely out of leading-strings, and the great national industrial establishments would prosper under absolute self-control, leaving the Government to attend to its own legitimate sphere.

Numerous examples might be adduced of the advantages which would result from a concentration of scientific and practical knowledge thus brought to bear upon the various departments of productive labour.

A desire not to trench too far upon your valuable columns, induces the writer however to draw to a close.

I am, Sir, yours, &c.,

A.

THE MIXED GAUGE.

A railway, on the double-gauge plan of Mr. Brunel, has been opened between Gloucester and Cheltenham, with a success unalloyed as yet by disaster, death, or damage; and certain journals which delight in doing honour to the whims of this eccentric engineer, are boasting of the result as the best possible refutation which he could have furnished of the published objections of Mr. Robert Stephenson to a mixture of the broad and narrow gauges. Now it can hardly be unknown to these braggarts—but whether known to them or no, it is due to truth that all the world should know—that the Gloucester and Cheltenham has always been regarded as an exceptional case in regard to the question at issue, and was expressly pointed out as being so by Mr. Stephenson himself. "*I do not think the Cheltenham and Gloucester will be a fair trial*"—Mr. Stephenson's own words. The reasons for its not being so, are well set forth in a letter from Mr. S. Sidney, to the *Railway Record*, from which we make the following extract:

"On the double-gauge line between Gloucester and Cheltenham there are no difficulties or dangers, because the stations of the Broad-gauge Company and of the Narrow-gauge Company at either terminus are *entirely separate*, and there are *no intermediate stations*, or *through crossings* joining the up line and down line. Mr. Stephenson has stated, in evidence, 'that the addition of a third rail into a common railway, where there are *no* stations or intermixture from *side to side*, is, vulgarly speaking, as plain as a pikestaff.' * * Mr. Brunel, on Parliamentary Committees, last session, having proposed to introduce the double-gauge system on upwards of 400 miles of railway, Mr. Stephenson was required to consider, not only cases "as plain as a pikestaff," like the Cheltenham and Gloucester, but also cases in which, in addition to the present inevitable complications of stations and crossings, the additional complication of a third rail would require to be added."

Another correspondent of the same journal forcibly observes:

"Mr. Robert Stephenson, in his Report, gives a detailed statement of thirty-nine accidents on the Midland Railway in one year only, all of which are attributable to crossing-points and switches. This is only with the one gauge; what, then, are we to expect, or rather what may we not fear, from the mixed gauge? Mr. Stephenson's Report is founded on practical experience, and not on supposition. Have not that gentleman's assertions been verified in the atmospheric affair, while the reports of Mr. Brunel have fallen—condemned, with the system?

"It appears that Mr. Brunel has now gratified his ambition; his success is considered complete. The expense ef this achievment is altogether left out of the question. In addition to the waste of capital, land, &c., for the broad gauge, an extra cost of 5,974*l.* per mile has been expended to form the mixed gauge. This is Mr. Brunel's engineering success!"

GIBBON'S PATENT IMPROVEMENTS IN TRUSSING BEAMS AND GIRDERS.

The requirements of railway and other bridge buildings, coupled with the excitement occasioned by the late accident at Chester, have strongly directed the attention of scientific men to the best means of obtaining increased safety for such structures.

Cast-iron girders of very large dimensions are now in constant use, and for security are trussed with wrought-iron rods, but from the changes which are continually going on in the crystalline structure of the metals, from unequal expansion and contraction by variations of temperature, as well as from causes of which as yet we know but little, great uncertainty prevails as to the permanent strength of such combinations. W. Gibbon, Esq., of Corbyns'-hall Iron-works, has recently devised and patented a plan for increasing the safety of cast-iron beams and girders in their various applications, which displays much ingenuity, although somewhat opposed to preconceived notions.

Mr. Gibbon proposes to abandon the rigid trusses heretofore employed, and to substitute others of an elastic nature, as will be understood by the accompanying diagrams, (somewhat distorted in dimensions and arrangement, to show them

Fig. 1.

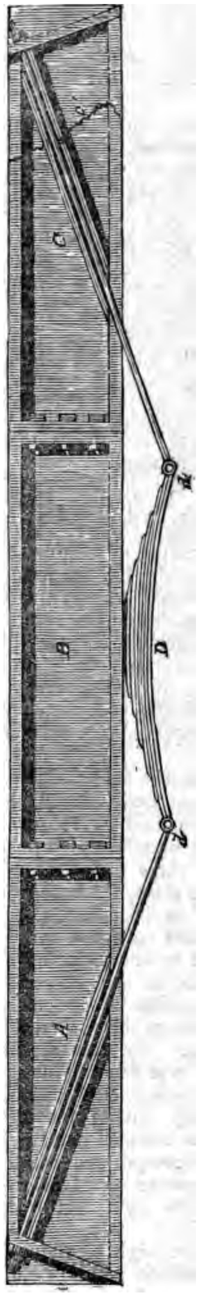
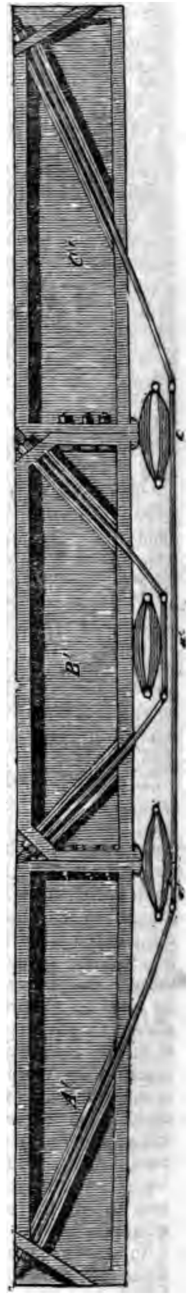


Fig. 2.



ly within the limits of a column.) 1, is intended to represent three cast-girders, A, B, C, of considerable h, bolted together in the usual way; abutment flanges at the extremities, pass down on each side and are ed to the ends of a powerful spring, hich abuts against the under side of entral girder, B. When the girder considerable width, several of these gs may be employed, ranged side by the bearing-rods, *d d*, being com- to the series. Fig. 2, shows another of spring, and also differently ar- ed. A′ B′ C′, as before, are three rs; tension-rods pass down on each from the two extremities, to a ontal bar which impinges on the gs, *e*, *e*, placed beneath the end es of the three girders. The cen- girder, B′, is trussed with a spring, a similar manner. Ribs are cast the girders, and form grooves for ension-rods to lay in, the interval een them being just sufficient to t the tension-rods, without their bound. In the event of a girder fractured, these ribs take a bearing le tension-rods, which prevents the n parts from falling asunder. This e seen in reference to the girder, g. 1, which is shown as fractured , but is preserved in tact by the on-rods. It is probable, indeed, f each of the girders was broken, the tension-rods, and springs would hold gether, if originally made as strong ider any circumstances they ought . Springs for locomotive engines constructed to bear upwards of ons in motion, and can be made stronger, especially when used st. If we suppose the case of a r, similar to fig. 1, and so wide as rmit six springs to be placed side le at D, each spring capable of bear- ight tons and brought to bear with force on the underside of the girder, e effect of this would be to ease the e of the bridge to the extent of y fifty tons, and that not varying under any changes of temperature. the Dee-bridge been thus protected nost likely it would not have fallen. e springs should, of course, be test- evious to being fixed, and should lowed but little play; perhaps half ich would in nearly all cases be ient.

B.

MR. SAMUEL'S RAILWAY EXPRESS ENGINE.—LIGHT ENGINES FOR LIGHT WEIGHTS.

To those who can read the signs of the future in the indications of the present, last Saturday was an epoch in railway affairs; for, on that day, "thought became a fact," pregnant with consequences. On that day, the resident engineer of the Eastern Counties' Railway, by the aid of *twenty-two hundred weight* of metal, timber, fuel, and water, conveyed seven persons from London to Cambridge, at the rate of 40 miles per hour—a feat which, up to that period, could only be accomplished by putting in motion *thirty tons* of inert matter. To those who ask the *cui bono?* we reply, that it is an indication of a reduction in the working expenses of railways, by the diminution of dead weight—an indication of increased durability of rails and roadway, and reduction in the cost of maintenance of way—an indication of greater speed than has yet been attained, and at a lessened cost—an indication of yet cheaper transit to the community, with increased profit to the shareholders—an indication of the extended use of railways, in many modes not hitherto dreamt of—an indication that steam carriages on railways may be advantageously applied to many purposes for which steam tugs (the existing locomotives) are not well adapted—and more than an indication, a direct offer, by authority, to the periodical press, to forward their reporters and messengers to the various scenes of their labours, on future occasions, at a cost of one-fourth the price hitherto charged. This is no merely curious experiment, but practical everyday business. Several pounds per day is the cost of an ordinary locomotive—fewer shillings is the cost of this new candidate for passenger transit. And be it remembered that this first "steam carriage" on railways, satisfactory though it be, still lacks the improvement of experience. The amount of improvement in the second of its class we cannot yet pronounce upon; but it is calculated that two tons of matter will convey twenty passengers, in a closed carriage, at the rate of sixty miles per hour; 40cwt. of dead load to 30cwt. of available load, or duty. And, after that experience be gained, it is probable that the third carriage will, with a dead load of 60cwt., convey sixty passengers, or 90cwt., for the dead load will diminish in proportion to the number of passengers.

A stage-coach of former times weighed about 1 ton; the four horses and harness, about 1½ tons—50 cwt.; guard and coachman, 3 cwt.; total, 53 cwt. By this apparatus, 17 passengers were carried at a rate

of 10 miles per hour; about 24 cwt.,—so that 2 cwt. dead load carried 1 cwt. available load.

An engine, tender, three first, and six second-class carriages, with driver, stoker, and guards, weigh about 70 tons on the Eastern lines. They will carry 192 passengers, at the rate of 30 miles per hour—about 288 cwt. of available load to 1,400 cwts. of dead load, or about 5 cwt. dead load to 1 cwt. available load.

A Great-Western express train weighs about 70 tons. The passengers, 128 in number, weigh about 9½ tons, which will be nearly 11 cwt. dead load to 1 cwt. available load.

The Eastern Counties' steam-carriage weighs 22 cwt., and carries 7 passengers, weight 10½ cwts.; about 2 cwt. of dead load to 1 cwt. available load. This is about equivalent to the old stage-coach, in proportion of materials, at quadrupled speed.

But, if at a future time, 3 tons of dead load will carry 4½ tons of available load, that will be the proportion of 1 cwt. of dead load to 1½ cwt. of available load.

It is not possible that principles of so great importance should be suffered to lie in abeyance; and we think that the Directors of the Eastern Counties' Railway have shown great clear-sightedness in sanctioning their engineer, Mr. Samuel, in so important an experiment. We foresee numerous purposes to which these steam-carriages may be applied, and shall be much surprised if the Post-office do not grapple at once with so cheap a means of rapid transit: and we shall also be surprised if it does not induce Directors to institute inquiries and experiments as to what amount of power is actually generated in their engines, for the purpose of overcoming their own friction. The result of this novel vehicle is most creditable to all the parties concerned. We believe that Mr. Samuel was the original propounder of it, for the Eastern Counties' Railway; and, when sanctioned by the Directors, the working drawings were made, under his superintendence, by his then assistant, Mr. Reynolds. It was constructed by Messrs. Adams, of the Fairfield Works, and we shall be glad to witness the launching of the second of its class from the same establishment.—*Railway Record, Oct. 30th.*

BOILER EXPLOSION AT ROCHDALE.

There has been a boiler explosion at New Hey Mill, Rochdale, by which four persons have been killed and several others severely injured. The evidence given at the inquest on the bodies of the deceased, discloses a state of things, which one would have supposed beforehand, could not possibly exist anywhere in the three kingdoms. The boiler was some twenty years old—so old that nobody could remember by whom it was made; it was originally wagon-shaped, but had some time or other been changed into the cylindrical form; the rivet-holes were much closer than usual, and the rivets were larger than should be put to a boiler with plates of ordinary thickness, and badly placed; thus "*taking away*," as the *Manchester Guardian*, justly observes, "*more strength from the plate than they gave to it.*" Again: the steam-gauge was without mercury—it was plugged with an iron plug, and the cock had not been turned for some years!!! Then, the safety-valve was of an area preposterously small compared with that of the boiler, and its spindle positively throttled by a hempen collar or stuffing-box. Mr. James Nasmyth, the eminent engineer, who was one of the witnesses examined, observed on this head:

"I have seldom seen a valve in so cruel a condition. A practice which I should much reprobate, is the application of stuffing to the valve. It is a very common practice, but it is a highly reprehensible one. I believe that the practice of covering and stuffing the valve, from the simple desire of preventing the steam coming into the engine-house, is exceedingly defective and improper. It would be doing a great public good to prevent the continuance of such things. When there is hemp round the spindle in this manner, and it is exposed to the action of water, an oxydation and fretting take place, and it is sure very soon to become rusty."

The Engineer, or "Engine-tenter," as he is called in Yorkshire, was every way worthy of the precious sort of engine he had to take charge of. He was a lad of eighteen, who had never had the sole charge of a steam-engine before, though he had assisted for three years working an engine at another place; and of his qualifications for the office he gave the following amusing proofs in answer to questions put to him:

"I never took the safety-valve out of the box to look at it; I used to oil the rods and things about it. I never had the stuffing-box out; sometimes there would be a little steam escape from the box, and sometimes a little water. I do not know that the valve ever stuck since I went to the mill: I had no means of knowing if the steam was too high, except by the valve—By the Foreman: I do not know how many pounds to the inch I used to work at: I thought I had nine pounds. I thought there were four square inches in the valve, and I multiplied the weight there was there by that four inches; that would be about 89 lbs.: then I divided this by nine, because I thought there would be as many

s as there were nine inches.—The Foreman: made you think about nine inches; where u get them?—The witness hesitated, and ards said, in answer to the Coroner,—*I know g at all about it, nor why I made these calcu-. I never learned any thing at all about it, ly from hearing other folk talk about it.*"

hearing the evidence of this fine men of the Rule of Thumb Boys, Nasmyth made the following very site observations:

om the engine being generally neglected, and ols being put into the hands of a person so intellect as this lad evidently was, he did all wonder at the boiler blowing up. To nachinery, on which the lives of so many s depended, in the hands of such a person, ery reprehensible; he might have gone to ve, given it a shake, and thought he heard am'; but it was very evident that, generally. w nothing about the matter. The boiler was ve, old, and patched, and was quite inade- o resist the pressure required; but of whatever h it might have been it must have given some time, with such a valve, and under management. It was very important that employing engine-men should pass them h some sort of catechising, to see that they ssessed of some small amount of intelligence, me fitness for the important station they There was more risk to the public from little petty concerns, where defective ma- r was employed, than from the largest esta- ents, in which there was a proper supervi-

e jury returned the following sen- verdict:

find that the safety-valve was defective in ction, and neglected in condition: that it the mercurial steam gauge was plugged a iron plug, and consequently useless; and to express a strong opinion, that the engine- is incompetent for his situation, and that blame is attachable to parties employing competent persons in such responsible si- s."

ATMOSPHERIC RAILWAY SYSTEM.

extract the following paragraph the *West of England Conservative:*

e atmospheric railway system of traction in constant operation, on the 15½ miles way, between Exeter and Teignmouth. are every day (Sundays excepted) propelled process, four passenger trains up, and three ger trains down, a heavy goods train, and le is accomplished with the greatest regula- The speed, which is admirably under con- averages upwards of 30 miles an hour; the es at the St. Thomas, Starcross, and Dow- tions, are so managed, that the trains are t to a stand still with the greatest ease and n—in fact, as easily as those propelled by motive engine: the starting from the re- stations is also conducted in a very inge- though simple, manner—atmospherically, assistance of an auxiliary tube. The train, usual signal—the guard's whistle—being gently runs on to the mouth of the conti- ube, a short distance from the platform, and ately as the piston enters, the full force of ospheric pressure is felt—the speed is in- , and the train rattles along with wonderful , which can at all times be checked and re- by the engineer, by the application of an ngly powerful break, which he can apply instantly and simultaneously to the six wheels of the carriage. In the course of a fortnight, the first atmospheric train will run to Newton—a distance of 20¼ miles from Exeter; and in a short time, we learn, the locomotive engines will be entirely removed from that portion of the railway. The tubing is also being laid towards Totness, the pipes being 22 inches in diameter, as the gradients between that town and Newton are very stiff: about a mile is nearly perfected, and a double line is constructing. The engine-houses are also rapidly progressing.

Have we still our doubts? Yes; because it is to be inferred from what is said about the *locomotive engines* being "in a short time" entirely removed, that assistance from them was requisite to produce the preceding results—because we are not told what the amount of that assistance has been—because we cannot imagine how a system which failed so utterly when tried between London and Croydon, under the most favourable circumstances should succeed so well between Exeter and Teignmouth—and because, finally, the real question remaining to be solved is, not whether railways can be worked on the atmospheric system—which has been long ago settled in the affirmative—but, whether they can be worked as cheaply and as conveniently as by locomotive carriages? On this point of expense our "Conservative" friend is silent.

MR. HUNT'S NEW DIVISION OF THE SUN'S RAYS.—LIGHT, HEAT, ACTINISM.

About six years ago, Mr. R. Hunt, of the Museum of Economic Geology, announced that he had discovered that, associated with the light and heat derived from the sun, there is another principle most active in producing changes in the organic and inorganic worlds. This principle he at first called *Energia;* but afterwards, on the suggestion of Sir John Herschel, it was called *Actinism* (from the Greek *ακτιν*, a ray of the sun.)

At a recent meeting of the Royal Cornwall Polytechnic Society, Mr. Hunt stated that all his scientific researches had fully confirmed the existence of the three principles; and he gave the following striking evidences of the truth of his discovery, derived from the vegetable world. That the actinic principle was necessary to germination, was shown by the fact, that seeds placed under the influence of solar rays transmitted through yellow glass, would not germinate, because yellow glass prevents the passage of the actinic principle. Accordingly, during spring, the solar beam contained a larger amount of the actinic

principle than at any other, because it was necessary at that season for the germination of seeds and the development of buds. In summer, again, there was a larger proportion of the light-giving principle, necessary to the formation of the woody portions of plants. And towards autumn, the calorific, heat-giving, or ripening principle of the solar rays increased. It resulted from these principles that the recent use in greenhouses of white German sheet glass was most objectionable. Under this kind of glass, plants were subject to an injurious solar influence which they had not suffered under the old crown glass. It became therefore, necessary, to discover some means to cut off those *parathermic* rays, which, passing through the white glass, scorched and browned particular portions of the leaves, without cutting off the other portions of the rays, which were necessary to the growth of the plant. With this view, Mr. Hunt has devised and applied at the Kew Observatory a green glass, stained with oxide of copper, which effectually excludes the injurious parathermic rays, while it admits the other solar rays necessary for the plant, as freely as ordinary white glass. In the manufacture of this green glass, it was essential that no manganese should be used, as was the case in white glass. If manganese were used, the glass would, after a while, assume a pinkish hue, which would more freely admit the burning rays.

AMERICAN TAPESTRY CARPETING.

This beautiful branch of manufacture, hitherto exclusively foreign, has recently been introduced into this country, and bids fair to become a profitable and extensive business. With that energy and enterprising spirit so characteristic of the mechanics and manufacturers of our country, Messrs. Clark and Hartman, of Clappville, Mass., have embarked in this business, and we are gratified to learn that it promises to be abundantly successful. We have seen specimens of their manufacture which are equal in appearance to the finest Brussels, and one of its peculiarities consists in having the figure beautifully and ingeniously printed upon *the warp* before being woven, instead of the insertion of the various separate colours during the process of weaving, as is generally practised in Europe.

The back of the web is of flax, or hemp, rendering it very strong and durable. It is woven on a simple common loom, requiring no extra harness or pattern-guides, as the figure, whatever its form or character, whether groups of flowers, landscape, or fancy sketches, must come in right in the weaving. The colours are laid upon the warp of the printing-machine with such mathematical precision that there is no possibility of getting the figures wrong. The entire machinery for this business is of American origin, and patented. It was invented by Mr. Hartman, who is by birth a Scotchman, but a naturalized citizen of the United States, having been in this country over twenty years, and was only acquainted with the Scotch plaid and ingrain carpet when he left his native home. He has been now more than three years perfecting his machinery and making experiments with his colouring-matter and process. He has now three printing-machines in operation that print *one hundred yards each per day*.* He has also about a dozen looms ready for weaving. The company have put up a building this spring for one hundred looms. The first piece of carpeting of the kind manufactured in America was made by this firm last April, and since that time until quite recently, they have done little more than make experiments in order to procure a perfect article. Mr. Hartman says, that in bringing out this machinery, he is not indebted to Europe for any part of it; and so confident was he of success, that he expended his whole property on it long before it was completed, and was only able to mature it by parting with one-fourth of his interest in the patent; and if he had failed, his family and himself must have been left pennyless. It gives us peculiar pleasure, however, to say that success seems to crown his efforts, while *he* rejoices that his invention is *altogether American*.—*Farmer and Mech.*——[" *Altogether American*," and yet the inventor a Scotchman !]

THE SCREW GUARD-SHIP "BLENHEIM."

The *Blenheim* steam guard ship was an old 74, built at Deptford, in 1813, and of 1,747 tons. She has had her poop and upper works cut down after the fashion of a flush-decked frigate, a gigantic specimen of which class of vessel she now appears, mounting on her upper deck two 56-pounders, 10 feet long, 88 cwt. each; two 10-inch beam guns on the quarter deck, 10 feet long; two 56-pounders pointing forward, and two beam guns, 10-inch; total on upper deck, eight, all on traversing pivots. On the main deck she carries 22 32-pounders, eight

* The plan of block printing on the warp was introduced into Scotland about eight years ago, and to this time, by their method, one man can only get off from ten to fifteen yards per day; but Mr. H. did not, nor does he yet know, their method of calculation for laying the figure, or preparing the colours. Mr. H. sets the colours by steaming after printing, and uses every variety of shade.

ng, and from 42 cwt. to 45 cwt. each. e lower deck, 26 42-pounders, 9ft. ong, and 67 cwt. each. Grand total nent, 56 heavy long guns. Her engines 450-horse power, by Messrs. Seaward apell, and of the direct action kind, ontal,) averaging 45 revolutions per e. Her screw is of 20 feet pitch with lades, and is worked by the engines ly. Her funnel is of the telescope and lowered by a winch. The vessel ried recently with all her sea-going ts in, and ballast in lieu of her sea-quantity of provisions and ammuni-

On this occasion she was under the rary command of Captain Horatio n, R.N., the able Government steam-nspector, assisted by Lieutenant Ro-n. The following is an authentic detail whole of her workings and perform-:

al distance run, 222 miles.

mber of hours under steam, 50¾.

total expenditure of fuel 84½, being rate of 36 tons for 24 hours.

maximum speed obtained with en-alone in a royal breeze, free, the s making 42 strokes, and the baro-25½, 6 6-10 knots.

maximum speed obtained with en-alone in a moderate royal breeze , 5 5-10 knots.

maximum speed obtained with en-and sail in a single reef topsail, and lant breeze abeam, the engines making volutions, and the barometer 24½,) knots.

maximum speed with sail alone, under me circumstances, 4 5-10 knots.

maximum speed obtained with en-and fore and aft sails in a moderate breeze, close hauled, 6 6-10 knots.

maximum speed obtained with sail under the same circumstances, 1 nots.

mean time occupied turning a whole ahead, 7½ minutes; ditto astern, 9 es.

e occupied in reversing engines from eed, 1¾ minutes.

e elapsed from engines being ordered reversed until ship went astern, 2 es.

e occupied in getting the steam up cold fresh water, temperature 56°, 1 16 minutes; ditto from cold salt temperatura 62°, 1 hour, 15 minutes. tting up the steam when her fires banked up, from salt water, tempera-40°, 45 minutes.

e occupied in raising propeller—*um*, 25 minutes; *minimum*, 15 minutes.

In lowering the propeller—*maximum*, 8 minutes; *minimum*, 5¼ minutes.

In lowering the funnel, 10¼ minutes; in raising it, 8 minutes.

At the measured mile in Stoke's-bay she went 6¾ knots.

THE "COURIER" STEAMER.—EXPERIMENTAL TRIP.

The *Courier* is an iron vessel, built for the New South Western Steam Company, by Mr. Mare, and fitted by Messrs. Maudslay and Field with engines on the much-approved annular plan of Mr. Joseph Maudslay, as also with the description of feathering paddle-wheel known as "Morgan's Improved," which this firm have for some time past adopted, as preferable, in their judgment, to any other. The vessel is of 439½ tons, 170 feet long, and 23 feet beam; the engines are of 200 nominal, but more than 400 real horse-power; and the wheels of 20 feet diameter over all.

On Friday last this vessel made her first experimental trip. She started from Blackwall at 10.35′ A.M., went as far as the Mouse Light, and was moored at Blackwall again at 4.30 P.M. The distance is called 104 miles, and is stated to be made up thus:

	Miles.
Blackwall to Gravesend	21
Gravesend to the Nore	23
The Nore to the Mouse	8
	52
	2
	104

Assuming these distances to be accurately computed, and making no deductions from the time occupied, 5 h. 55 m. in all, for incidental hindrances, it follows that the vessel must have gone at the amazing *average* rate of not less than 17½ statute miles per hour. In returning (with the tide,) the 21 miles between Gravesend and Blackwall were said on board to have been actually performed in 59 minutes; but we had by that time closed our note-book, and though we have no doubt of the fact, we cannot bear our own personal testimony to it.. The greatest number of revolutions of the wheel per minute, noted by us was 40, with the steam at a pressure of 16 lbs. and vacuum of 26¾. The time occupied in going down to the Mouse, against the tide, was 3 h. 20 m., and in returning, with the tide, 2 h. 35 m.

RECENT AMERICAN PATENTS.

IMPROVEMENT IN THE PEN OR PENCIL CASE. *Albert G. Bagley.*

The patentee says,—"The ordinary pen or pencil-case is constructed with one tube or barrel, and the holder of the pen or pen-

cil, which slides in and out of it. This contrivance is found to be inconvenient, on account of its length, and the object of my invention is, to obtain the same length of pen-case, when extended, with the advantage of being not more than one-half of the ordinary length, when closed or slided in. This I effect by making my pen-case of two tubes or barrels, one sliding into the other, and the pen or pencil holder to slide within them."

METHOD OF IMPREGNATING TIMBER AND OTHER POROUS BODIES. *Peter Von Schmidt.*

Claim.—"What I claim as my invention, for the purpose of impregnating timber or any other porous substance by any desired fluid, and to encrust or char said wood, in a complete manner, in heated oil, is the following combination of the operations, viz., The steaming of wood in combination with exposing the same immersed in any desired fluid to a vacuum; further in combination with the application of high pressure by a hydraulic press pump; and, finally, if required, in combination with charring or encrusting by coal, the impregnated wood in heated oil, as set forth. All these operations are done in one and the same apparatus. By the different combined actions upon the wood, a perfect impregnation is accomplished, and by the encrusting or charring of the wood in heated oil, the timber so prepared is more lasting and durable than iron; therefore the combined actions upon the timber, as set forth, have the advantage over all other modes to saturate or kyanize timber which have been practised heretofore."

AN INSTRUMENT CALLED THE SAW-DRESSER, FOR RE-CUTTING THE TEETH OF SAW-MILL SAWS. *Apollos B. Spencer.*

A frame is so formed that it can be clamped to the saw, with a rest or die, that rests against the edge of a tooth, and made adjustable to suit different sizes. A cutting burr is hung in a secondary frame, which slides in the clamped frame, at an angle to correspond with the slope of the teeth, so that by sliding the secondary frame, and rotating the burr, the teeth will be cut.

IMPROVEMENT IN THE METHOD OF BREAKING, FLESHING, AND UNHAIRING HIDES. *George Welty.*

The patentee says,—"The nature of my invention and improvement consists in a new mode of working hides by power-machinery, instead of hand: that is to say, taking the hides, after being properly soaked, and subjecting them to the action of a series of parallel serrated plates (for breaking and fleshing the hides,) placed on the periphery of a revolving cylinder, arranged immediately above a revolving drum, for sustaining, raising, and carrying forwards the hides, between the cylinder and drum—the hides being introduced from an inclined table and roller—the effect of said serrated plates being to break and flesh the hides, as they pass between the said cylinder and drum,"

IMPROVEMENT IN THE BLACKSMITH'S TUYERE. *Charles W. Grannis.*

Claim.—"What I claim as my invention, is causing the blast to descend, and then ascend, before leaving the tuyere, by curving the orifice down, and then enlarging it upwards, by which I obtain an elevated blast, and prevent the tuyere from clogging, in combination with a valve placed below the draught, so that on elevating it the draught will be contracted from below."

MACHINE FOR PUTTING BOOTS AND SHOES ON THE LAST. *Silas Hart.*

The patentee says,—"The nature of this invention and improvement consists in contracting and expanding the arms containing the jaws for gripping the edges of the upper of the boot or shoe, by means of a slide that embraces or encircles the arms, said arms being moved towards or from the last, simultaneously with the operation of turning the male screw in a female screw in the centre of the nut, to which they are connected, by which the angle of the arms with the screw is diminished by lasting the upper, and increased in unlasting it, by reversing the operation of the screw; thus removing the objections existing in the use of the machine, where the arms are expanded and contracted by a separate screw, managed at right angles to the main screw, and possessing the advantage of drawing the edges of the leather inward towards the shank, and outward towards the side simultaneously, at the single operation of turning the screw against the last."

IMPROVEMENT IN THE VALVES OF STEAM-ENGINES. *H. Olney, J. H. Whelpley, and D. G. Raven.*

Claim.—"What we claim as our invention, is the method of inducting and educting steam to and from the cylinder of one engine by means of a hollow piston-rod in two parts, connected to and united by a piston, in which are placed induction and eduction slide-valves, operated by thin projecting ends striking against the heads of the cylinder, as the piston approaches them in performing its reciprocal vibrations—the induction valve being in connection with one portion of the piston-rod, and the eduction valve with the other portion of the same."

IMPROVEMENT IN THE EVER-POINTED PENCIL. *A. G. Bagby.*

Claim.—"What I claim as my invention, is the mode herein set forth of forming a bottle or receptacle for surplus leads in the inner cylinder, within which the traveller works, by introducing slips of sheet metal or tubes, to keep the leads from obstructing the passage of the traveller, and to form compartments for the leads to be deposited, in combination with a cap, to screw or slide on the end of the cylinder, so as to keep the leads in the compartments."

IMPROVEMENT IN THE STEERING-WHEEL. *R. C. Holmes and J. J. Springer.*

The patentees say,—"The nature of our invention consists in the employment of two grooved rollers, mounted in appropriate bearings, one above the other, on the helm, the upper one being on the shaft of the tiller-wheel; and mounting the tiller-rope, by first attaching one end of it to one side of, and near the extremity of, the helm, passing it through a block attached to the side of the vessel, then through a block attached to the same side of the helm, then over the upper drum, and in the first groove, then under the lower drum, then around the upper drum, and in the second groove, then around the lower drum, and in the second groove, and so on to the end, each time crossing the rope, to insure the bight thereof, and then from the upper drum to a block attached to the side of the helm, and just opposite to the attachment of the rope, on the other side, and thence carrying the rope through a block at the side of the vessel, and then tying the ends to the helm, at a point just opposite to the block on the other side; so that, by this arrangement of the grooved drums, and the disposition of the tiller-rope, it (the rope,) is prevented from slipping and over-riding, and, at the same time, it is prevented from making slack, as the helm vibrates, for the slack is taken up on one side as fast as it is made on the other, and the rope is also prevented from chafing."

FOR AN IMPROVEMENT IN THE ESCAPEMENT FOR WATCHES. *Charles E. Jacot.*

Claim.—"I do not claim to have invented a new watch; but I do claim as new, and of my own invention, and desire to secure by letters patent, the application of a roller on the balance-staff made of ruby or agate, or other proper material, fitted with a groove to take the end of the lever, and the combination therewith of a crown or contral wheel, fitted or constructed with conical teeth having radial axes, and acting conjointly with pallets fitted to coincide with the wheel-teeth; ihe whole constructed and operating substantially as described."

IMPROVEMENTS IN LOCOMOTIVE STEAM ENGINES. *Ross Winans.*

Claim.—"What I claim as my invention, is the employment of wheels of small size, with wrought or soft iron flanches, in combination with an engine having six or eight driving-wheels with axles, parallel to each other, and accommodating itself to curves and turnouts, and having the power applied to all the axles by connecting-rods and cranks."

IMPROVEMENT IN FISH-HOOKS. *Theodore F. Engelbrecht and G. F. Skiff.*

This improvement consists in jointing to the stem of a fish-hook another hook, which is forced down by a spring. When set for fishing, the extra spring hook is held up by a sliding catch connected with the line, and when the main hook that carries the bait is pulled by the fish, this liberates the spring hook, which catches on to the fish.

TYRE FOR RAILROAD WHEELS. *D. Saunders, J. G. Bisset, and S. Saunders.*

The following is the mode of procedure:—A pile of iron and steel is made as follows—first a large bar of iron, then a thin bar of steel, then another bar of iron, the latter being thin, and serving only as a protection to the steel from being burnt in the process of welding, the whole is then welded. The bar is then passed through a series of rollers giving the required shape to the tyre, shrunk on to the wheel, and the thin plate of iron turned off to expose the steel to the surface.

RAILWAY BUFFERS.

Sir,—I would beg to suggest the propriety of having railway buffers at one end of each carriage, instead of at both ends, and letting them abut upon a perfectly plane surface. The rods, &c., must, of course, be made of proportionate strength; but the buffers would have no tendency to ride, which they now have, when the rods of those in contact are not in the same line.

I am, Sir, yours, &c.,
S. Y., an Engineer.

October 12, 1847.

[Buffers with plane or flat surfaces were tried long ago, and are still in use for goods' wagons; but it has been found that they have just the same tendency to ride as others. ED.]

HOW TO CLEANSE MEERSCHAUM PIPES.

Sir,—The objection raised against the cleansing of meerschaum pipes, by a correspondent in the *Mechanics' Magazine* for April, is completely overruled by the following method:—Apply the head of the pipe to any small cock connected with a steam-boiler, then turn the steam through it (this

must be done without the tube); afterwards apply the tube in like manner.

After this operation, they smoke much sweeter than when new.

I am, Sir, yours, &c.,

W. KENT.

Bury, August 17.

LIGHTING BY ELECTRICITY.

The Literary and Philosophical Society of Sunderland—one of the most popular, flourishing, and useful Institutions in the north of England—gave a public soirée last week, at which the great attraction of the evening is stated to have been an exhibition of Mr. Staite's new mode of lighting by electricity. We extract the following paragraph on the subject from the *Newcastle Guardian*:

"The light, which was of astonishing brilliance and beauty, was placed under an air-tight glass vase. When the gas was turned down, it sufficiently lighted the spacious building, and bore the closest resemblance to the great orb of day of any light which we ever witnessed. The electric light was afterwards exhibited in a vessel of water with equal success, the exhibitor humurously remarking, that it was thus proved quite possible "to set the Thames on fire." Mr. Staite stated that this light is economical as well as beautiful—the cheapest, as well as the best, for all practical purposes. It seems almost needless to add that this marvellous invention was hailed with rapturous plaudits."

In a lecture afterwards delivered, Mr. Staite gave the following comparative statement of the expense of the electric light, as compared with other modes of lighting:

"With a battery consisting of forty small cells in series, the light was equal to 380 tallow candles, 300 wax candles, or 64 cubic feet of gas, this being effected by the consumption of little more than three-quarters of a pound of zinc per hour. The relative cost was by the electric light 1d., gas 6d. to 8d., tallow candles 7s. 6d., and wax candles 12s. 6d. per hour—so that there was no light so cheap, as well as none which exhibits such pure and brilliant results."

The apparatus employed by Mr. Staite at Sunderland is, we believe, on a plan somewhat different from those formerly patented by him, and described in our pages (see vol. xlv., p. 160, and vol. xlvi., p. 621;) and forms the subject of a new patent, which has not been yet specified.

INQUIRIES AND ANSWERS TO INQUIRIES.

Tolls on Common Road Steam Carriages.—"Will the Editor, or some of the correspondents of the *Mechanics' Magazine*, be so kind as to inform me why our road commissioners have ordered that every steam-carriage passing through the toll-bar of a common road should have to pay two shillings? I have long had a project in view of making a small private steam-carriage to carry two persons. Now, how should I be placed with regard to toll, supposing the affair weighed about five or six cwt.? Should I have to pay this enormous sum for my novelty, for so small and light a vehicle; or would it be liable to no more than the reasonable and ordinary toll of other conveyances of equal weight? Is there not a lawful means of avoiding this imposition? Supposing the carriage were to stop within 100 yards before it came to the bar, and be pulled through by a lad, until it was 100 yards on the other side, would not this avoid all claim? It is rather a shabby expedient; but considering that, to go eight miles on a common road it is a serious matter to have to pay twelve shillings, at the very least—three-fourths of which sum being an improper demand, and out of all reason for a small pleasure steam-carriage,—a demand which would at once put a stop to any engineering project of the kind, even were the invention ever so plausible. I will feel obliged if some one will give me a little information on this subject, which is of considerable importance to the public at large, in these days of advancement in engineering accomplishments."—*An Enquirer, Leeds.*

[The toll is exacted, no doubt, under the authority of some existing Act of Parliament, and could not be evaded in the way proposed. The only remedy is to get the law repealed. ED.]

Specific Gravities.—"A wagers with B that two pints do not always make a quart." A has won. For example, a pint of water and a pint of sulphuric acid will not make a quart, and the "half-and-half," in this case, make a whole, which is less than either half doubled. The reason is, that the constituent atoms or particles of different bodies are not all of like form and magnitude—a truth not demonstrable to sight or touch, yet plainly deducible from many observed facts.

Wire Ropes.—"D. T.," though a "practical miner," seems to be but indifferently informed on this subject. It has never been clearly ascertained who first suggested the idea of using metallic wires instead of yarns of fibrous material for making ropes. For anything that has yet appeared, the French are entitled to the credit. The late Sir John Robison saw wire cordage used in the machinery of the Opera at Paris, in 1822; and, in the report on Harris's Lightning Conductor, laid before the Lords Commissioners of the Admiralty in 1839, it was stated that wire ropes had been used as lightning-conductors in the French navy; nay, a piece of wire rope, obtained from the frigate *Calypso*, when at Chatham in 1822, was actually produced for the inspection of the committee. Experiments on the subject of their application as ropes for mines were made at Freyberg, in Saxony, in the year 1827, but

not till 1834 that they were success-
ised in the mines of the Harz Moun-
The suggestion of the plan then
d, is due to M. Albert, director-in-
of the Hanoverian mines. In the
of a short time wire-ropes completely
eded the hemp ropes and chains used
se mines. In France a great many
ision-bridges have been made during
t twenty years; the suspension-cables,
formed, however, simply of parallel
it wires, bound together by wires
l round them. Descriptions of these
ublished in this country in 1825, and
l are described in "Drewry on Suspen-
Bridges," published in 1832. In
Mr. Andrew Smith took out a patent
nprovements in the manufacture of
which were to be made in a similar
r to *common* hemp ropes, by *twisting*
together into strands and ropes. Ropes
s plan were for some time used on the
wall Railway, but have now been super-
by those patented by Messrs. R. S. New-
l Co., of Gateshead, in 1840 and 1843;
are made by machinery invented for
irpose, and by which a motion is given
ch wire, so as *to prevent* its being
d, while the wires, generally six in
er, are laid symmetrically round a
to form the strand; and the strands
generally six) round a core to form the
so that the wires are all of the same
, and are subjected to an equal strain.
is means *the greatest possible* strength
ained from the material employed.

ution of Silk.—"Some time ago it
nnounced, that a method of dissolving
ad been discovered abroad; and I see,
e newspapers, that an attempt is now
g to coat cotton thread with a solution
k, so as to give it the appearance of
Can any of your correspondents give
nformation as to the liquid employed?
subject well worthy of attention."—
C. C., Oct. 30, 1847.

NOTES AND NOTICES.

etual Motion.—A correspondent of the *Mid-
Counties Herald*, says, "a poor framework
r, of Hinckley, named Joseph Hutt, has, after
years' application and study, completed a
ne which he calls a 'self-moving machine
rpetual motion.' He set it in motion on
th August last, since which time it has con-
to work with the greatest regularity. The
ns of the machine are both quick and power-
d may be greatly increased and applied to
irpose. It does not require the aid of steam
other power to keep it in motion, having one
ual and regular movement of its own. Hutt,
s a poor man, is anxious to obtain assistance
ble him to test still further the value of his
ion." The best thing which the friends and
ours of this "poor man" could do for him
be, to make him a present of some standard
on mechanics, (say Gregory or Moseley,) from
he would learn *that the object he is aiming
at is a positive impossibility.* And, if it can be done, without danger of offence, or undue excitement, we would recommend them to couple with it a copy of Beattie "ON TRUTH."

Fauvelle's Boring Apparatus, which attracted so much attention at the Southampton Meeting of the British Association two years ago, was referred to a committee of the late Italian Congress of Science, at Venice, who made a report upon it, of which Mr. William Pole gives the following account (*Mining Journal*, Oct. 30): "The commission appointed upon the subject of Artesian wells announced, they had this month commenced, and repeated with the happiest result, the experiments for which a certain grant was set aside—namely, to prove the practicability of Fauvelle's method of boring—extracting the material excavated by the injection of water, without withdrawing the auger. Details were given of the experiments, and the result appeared to justify the opinion, that, where the strata were not absorbent, the method alluded to rendered the operation more easy, expeditious, and economical."—For details of the process see *Mech. Mag.*, vol. xlvi., p. 308.

The Hudson's Bay Company's Arctic Expedition —In July, 1846, the Hudson's Bay Company despatched an expedition of 13 persons from For- Churchill in Hudson's Bay, under the command of Dr. John Rae, for the purpose of surveying the unexplored portion of the Arctic Coast at the north-eastern angle of the American continent. This expedition has now returned, after having traced the coast all the way from the Lord Mayor's Bay of Sir John Ross to within a few miles of the Straits of the Fury and the Hecla—thus proving Sir John Ross to have been correct in stating Boothia Felix to be a peninsula, and a portion of the American continent.

Simpson's Submerged Horizontal Side-Propellers. —Since the account of these given in our first article was in type, the *Albion* has made a second trip, which is described to us as having been even more successful than the first. The Earl of Dundonald and Admiral Sir Charles Malcolm were present on the occasion, and expressed a highly favourable opinion of the invention. More in our next.

New Application of the Centrifugal Governor.—Among the latest fruits of American ingenuity, is a horse-power to which a centrifugal governor (like that used in steam-engines) is attached, which of its own accord pulls up the horses when they go too fast, and begins whipping them the moment they loiter.

Etherization of Old Date.—In Middleton's tragedy of "Women Beware Women," published 1657, there is the following passage:

"I'll imitate the pities of old surgeons
To this lost limb, who, ere they show their art,
Cast one asleep; then—cut the diseas'd part."

Railway Speed.—The railway papers are boasting of a man who lately travelled 713 miles in 26 consecutive hours. This is idle, after it has been shown that a speed of a mile a minute is quite *within* the mark. Had the traveller done twice 713, or 1560 miles during the 26 hours, that would have been something to talk about.

Clean Hands—Soft Hands.—Lewenhoeck mentions the case of a master carpenter, "who was likewise a diligent workman," whose hands were "as soft in the palms as if he had never been used to labour." The philosopher asked him how this was? The man replied—"I wash my hands ten times a day, at least, for I hate to see them foul."

Second Tunnel Bridge.—One of these wonders of the age, the Tubular Bridge over the Conway, is so far advanced towards completion, that its erection is expected in the course of the ensuing month. The site of the bridge is on the south side of Telford's "suspension-bridge," close to the wall of the Conway Castle Bridge (also by Telford.) It will be precisely of the same description as the one to be thrown across the Menai Straits, the Conway Bridge consisting of two tubes or tunnels (one for the up and the other for the down line of rail,) each 400

feet in length. It is rectangular in form, consisting entirely of sheet iron, one inch in thickness. The inside, through which the trains are to pass, is 24 feet high and 15 feet wide. The outside height is much greater, being about 30 feet. The top is of two thicknesses of corrugated metal, forming a series of circular tubes of about three feet in diameter. This form is considered to offer the greatest resistance to compression. The sides are of sheet iron of one thickness; the bottom has a double thickness, three feet apart, connected by intermediate longitudinal ribs, so as to give the necessary stiffness for the carriages to pass over. The whole mass, weighing upwards of 1,000 tons, will be placed on the abutments at once. The place where it is being constructed is on a huge timber platform, in a curve of the Conway, a few hundred yards from the intended site of the bridge. Immediately the tube is completed, with the aid of a flood tide and pontoons, it will be raised so as to admit of the platform on which it is erected being carried away.—*Shrewsbury Chronicle*

Theory and Practice.—The celebrated Colin Maclaurin, and scarcely less distinguished Dr. Desaguliers, were applied to by the City of Edinburgh to calculate the quantity of water which might be supplied to that city by a train of pipes of certain given dimensions, The quantity actually obtained was only about one-eleventh of Maclaurin's calculation, and one-sixth of that of Desaguliers's.

WEEKLY LIST OF NEW ENGLISH PATENTS.

Meyer Meyer, of Artillery-place, Finsbury, Middlesex, for certain improvements in the manufacture of umbrellas and parasols. November 2; six months.

James Walker, of Glasgow, gentleman, for improvements in weaving. November 2; six months.

Thomas Dunn, of the Windsor Bridge Iron Works, Manchester, for improvements in the manufacture of railway wheels and axles, and in machinery and apparatus for placing carriages on to a line of rails, for removing them from one line of rails to another, and for turning them. November 2; six months.

William Boulnois, of Baker-street, Portman-square, Middlesex, gentleman, for improvements in draught harness. November 2; six months.

Jean Charles Victor Coullon, of Auxerre, France, for improvements in propelling vessels. November 2; six months.

Anthony Bernhard Von Rathen, of Putney, Surrey civil engineer, for improvements in obtaining and applying motive power. November 2; six months.

William Longmaid, of London, gentleman, for improvements in the manufacture of alkali and chlorine. November 2; six months.

Thomas Langton, of Bullwell, near Nottingham, for improvements in the manufacture of knitted fabrics. November 2; six months.

James Murdoch, of Staple-inn, Middlesex, for an improved capsule, or small case for protecting matters inclosed therein from the action of the air, and an improved material to be used in the manufacture of the said capsules. November 2; six months.

Thomas Hancock, of Stoke Newington, Middlesex, Esq., for improvements in fabrics elasticated by gutta percha or any of the varieties of caoutchouc. November 2; six months.

. Richard Laming, of Clichy la Garonne, France, for certain improvements in manufacturing and purifying coal gas, and in treating a residual product of such manufacture; also improvements in preparing materials to be used in the purification of coal gas. November 4; six months.

Charles Low, of Rosebery-place, Dalston, Middlesex, gentleman, for improvements in the manufacture of zinc, copper, tin, and other metals. November 4; six months.

Cyprien Marie Jessie Du Molay, of Paris, gentleman, for improvements in inlaying and coating metals with various substances. November 4; six months.

John Lawson, of Paisley, North Britain, for improvements in machinery for separating burs, seeds, and other matters from wool, cotton, and other fibrous substances. November 4; six months.

George Wells, of 7, Penton-place, Walworth, Surrey, for a machine for the purpose of causing communication between the guards and engine-drivers of railway carriages whilst travelling on railways, and also for communication between vessels at sea and the shore, and for other similar purposes, and which invention it is intended to call "An Atmospheric Signal by Land or Water." November 4; six months.

Jean Marie Durafour, of Lyons, France, for a new fastening, or improved system of lacing without eyelet-holes. November 4; six months.

Joshua Procter Westhead, of Manchester, for improvements in the manufacture or treating of India-rubber. November 4; six months.

James Pedder, of New Union-street, Middlesex, engineer, for certain improvements in steam-engines, and in propelling. November 6; six months.

Robert Davison, of New Broad-street, London, civil engineer, and William Symington, of the same place, civil engineer, for certain improvements in the application of heat to the preparation, desiccation, and preservation of bread stuffs, confectionary, pulse, meats, vegetables, and other edible substances. November 6; six months.

WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

Date of Registration.	No. in the Register.	Proprietors' Names.	Addresses.	Subjects of Designs.
Oct. 30	1245	H. and R. Heywood	Burslem, Staffordshire, and 115, South Wharf, Paddington	Heart-shaped drain-pipe.
„	1246	John Randolph Remington and William Simonett	Kennington	Portable gas water-lamp.
Nov. 1	1247	George Chambers & Co.,	Studley, Warwickshire	Crotchet needle.
2	1248	Joseph Burdett	9, Gloucester-street, Queen-square	Expanding sofa-bedstead.
„	1249	J. Guise	75, Margaret-street, Wilmington-square	Glass deflecter for gas-burners and lamps.
„	1250	John Henry Sadler	Brentwood, ironmonger	Candle-guard.
„	1251	John & James McRae,	17, Ave-Maria-lane, City	"Porte Graphite," or mechanics' companion.
3	1252	Richard Thompson Furness	40, New Church-street, St. Marylebone	Glass rotary ventilator.

NOTICES TO CORRESPONDENTS.

J. W.'*s problem has already appeared in another journal, from the correspondents of which it will, no doubt, receive due attention.*

N. C. D.—*Curious and interesting, but requiring more space than we can afford.*

Communications received.—*P. B.—Handsaw—L. L.—Alpha—Paul Plain.*

Erratum.—*In the account of the improvements in guns and cartridges, given in our last number, for* Jager, *read* Jaeger. *The inventor is Dr. Jaeger, a physician of Vienna.*

CONTENTS OF THIS NUMBER.

LONDON: Edited, Printed, and Published, by Joseph Clinton Robertson, of No. 165, Fleet-street, in the City of London.—Sold by A. and W. Galignani, Rue Vivienne, Paris; Machin and Co., Dublin; W. C. Campbell and Co., Hamburgh

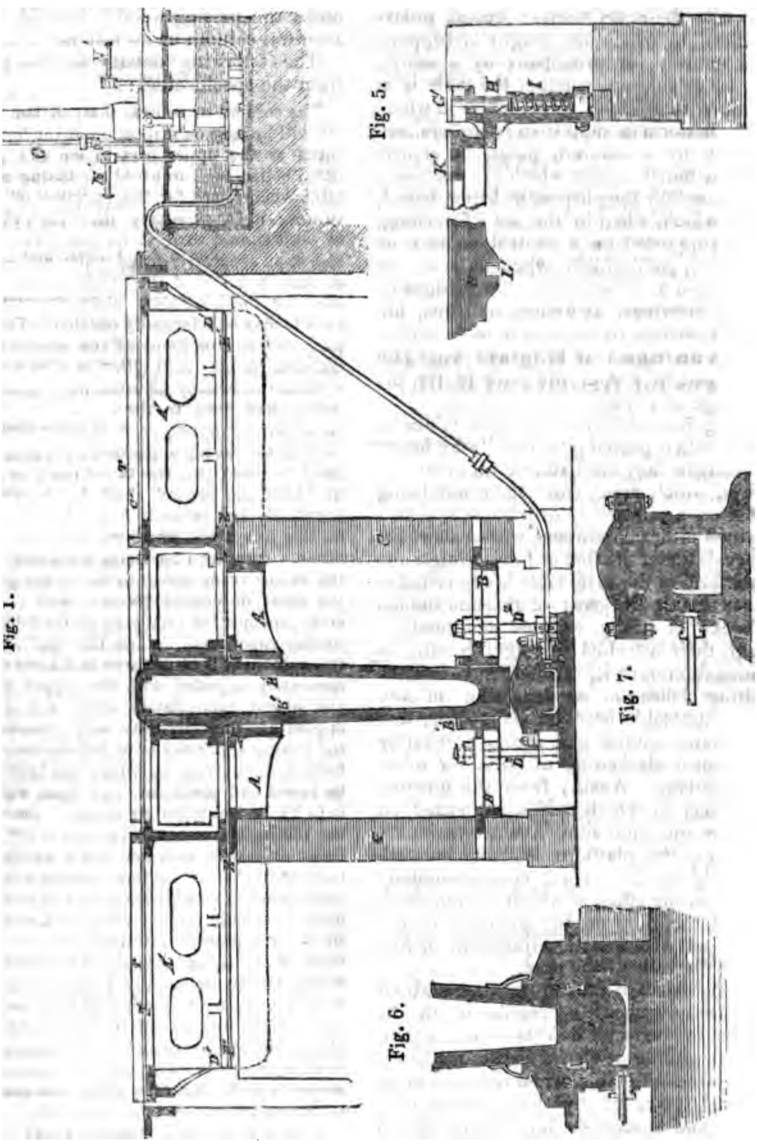
Mechanics' Magazine,

'SEUM, REGISTER, JOURNAL, AND GAZETTE.

1266.] SATURDAY, NOVEMBER 13. [Price 3*d.*, Stamped, 4*d.*

Edited by J. C. Robertson, 166 Fleet-street.

BROOMAN'S PATENT IMPROVEMENTS IN TURN-TABLES.



BROOMAN'S PATENT IMPROVEMENTS IN TURN-TABLES.

[Patent dated 29th April, 1847; Specification enrolled 29th October, 1847. Invention communicated by a Foreigner residing abroad.]

There are four kinds of turn-tables at present in use: first, those supported, when at rest or in motion, by rollers at or near their peripheries; second, pillar-tables, in which the weight is supported entirely, or principally by a central pillar or column, whether the table is at rest or in motion; third, tables in which the platform is supported by rollers, and partly by a column, pillar, or central shaft; fourth, tables which are depressed or raised for the purpose of being turned, and which, when in the act of turning, are supported on a central point or on rollers, and which, when at rest, are sustained at or near their outer edges on fixed bearings, as wedges or cams, but which wedges or cams have to be shifted when the table is to be turned, and again replaced to render the table fit for the passage of a train.

A general defect of these turn-tables is, that, when passed over rapidly by heavy carriages they are liable to tilt or to deflect, which arises from their not being laid on a sufficiently firm basis, and sustained either continuously or at short intervals under the line of rails. Unless the platform of the turn-table is supported so as to sustain the great weights and sudden shocks of heavy engines and tenders, with their attached carriages passing in succession over it, without any sensible tilting deflection or depression in any part, the table becomes dangerous, and the trains cannot pass across it in safety without a slackening of speed or other precautions. Again; from the unequal bearings to which tables supported on rollers and other similar contrivances are subject, the platform is liable to turn slightly as the weight comes suddenly upon it, the effect of which turning is to throw the rails on the platform of the table out of accurate adjustment or line with the rails of the road.

The object of the improvements which we are now about to describe is, to obviate the various defects above stated. Their leading or characteristic feature is this—that the table, when required to be turned, is raised by the pressure of a fluid, and sustained whilst being turned upon the fluid by the pressure of which *it was so raised*, and when turned to the *required position*, lowered by withdrawing that pressure, and that the table, when not required to be turned, rests on continuous or solid stationary bearings under the passing weight, instead of on a central column or on rollers.

The following details are extracted from the specification:

The column or central shaft of the table, (as will be seen on inspection of the figures,) turns at the upper part in an accurately-fitted collar, and, to avoid the tilting of the table when raised for the purpose of being turned, it is necessary that the column or shaft should turn at its lower extremity also in an accurately-fitted collar or bearing, so that the effect of the weight at the outer edge of the platform, when the table is raised, may be effectually resisted. For this purpose, the lower end of the shaft or central column may turn either in a lower ring or collar accurately adjusted with the upper collar, and fixed in the brickwork of the continuous support, or it may be held and turn in the raising apparatus; but great care must be taken that the two collars or rings in which the central shaft is to turn are accurately and securely fixed, so as not to be able to get out of adjustment with each other. Another important consideration is, the having ready access to the lower part of the shaft or central column, with suitable arrangements for removing or repairing the raising apparatus. When the shaft or central column is held or turns in a lower collar accurately adjusted with the upper collar, and placed immediately above the raising apparatus, the only duty and operation of the raising apparatus is to lift the table and furnish the bearing by which the table is to be raised and sustained, and upon which it is to be turned when so raised. But when the raising apparatus also serves as the fixed collar or bearing in which the lower end of the central shaft or column turns, the raising apparatus has an additional duty to perform, namely, to hold the lower end of the central shaft, and prevent the tilting of the table when it is being turned. The tilting to which tables are usually subject when the weight is at the outer edge, as each carriage comes on to or goes off from the platform of the table, is prevented by the bearings at or near the outer edge and the continuous supports under the rails which the peculiar arrangements of this table admit of.

Figs. 1 and 3 are sectional views of the table and raising apparatus, showing also the force or injecting pump and main bearers or girders of the platform of the table, of

Fig. 4.

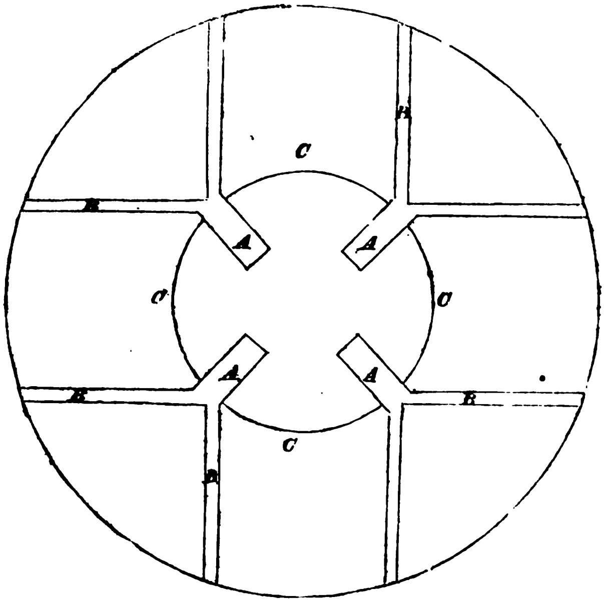
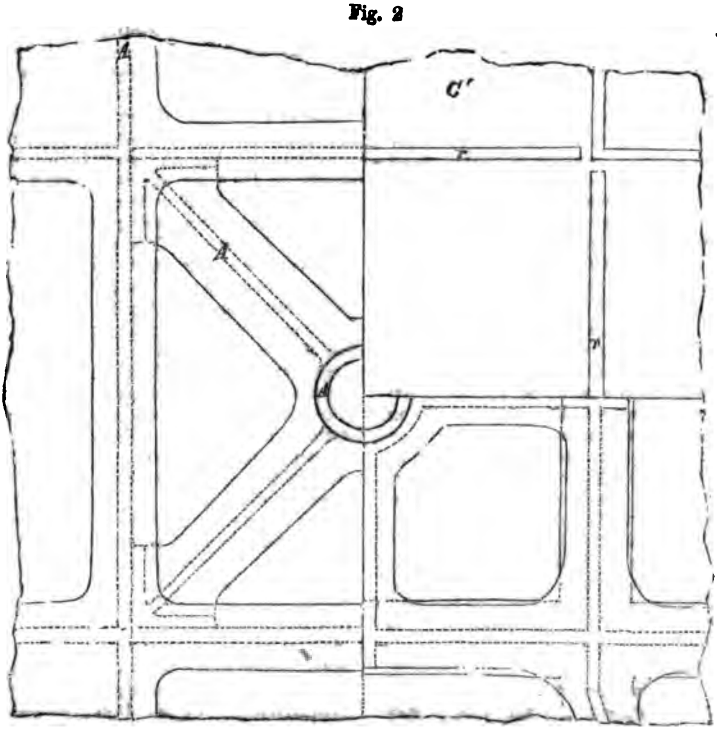


Fig. 2



which figure 2 is a plan. Figure 5 is a sectional view, showing a stop for the purpose of ensuring the table, after being turned, stopping in such a situation that the rails on the platform of the table may be in accurate adjustment with the rails of the line.

The framing and construction of the platform of the table may be made according to the pleasure of the engineer, provided that the main bearers or girders, A^1A^1, (as shown in figs. 1 and 3,) are sufficient to sustain the weight of the carriage, with its load, without deflection at the outer edge when the table is lifted for the purpose of being turned, and that the platform is firmly connected with the central column or shaft, B^1. It will be observed that the main bearers or girders of the table are sustained either continuously under the lines of rails, *rr*, or as on a square in the middle of the table (as shown in figure 2,) according to the width of the gauge, and also near the edge of platform C^1, under the points, D^1D^1, over which the trains pass on and off the table in the ordinary working of the railway. Thus there will in all cases be a firm support near the outer edge of the table and across the table in the line of the rails of the railway. Fig. 4, shows a plan of foundations, which may be convenient in some cases; the projections, AAAA, at the junction of the walls, BB, presenting buttresses, upon and into which corresponding projections of the upper and lower collars, or the raising apparatus, afterwards explained, may be set. This arrangement of the foundations may be found convenient for railways of the broad gauge; it also has the advantage of giving more room in the central pit for the raising apparatus; the access to which may be from above, through the platform, either directly into the central pit or through an arch in the circular walls, CCCC. Whatever kind of support is adopted, the patentee recommends that the girders of the table should rest on a partially elastic bed, E^1E^1, as of caoutchouc, gutta percha, or any of their known preparations, or other suitable elastic substance, so as to obviate the effect of the shock on the trains passing over the platform, and on the lowering of the table on to its solid bearings after having been raised. It will also be obvious that the platform may be sustained on framings of wood placed on the cross walls of the inner pit, extending to the outer wall or curb, and that it will not in general be necessary to excavate the whole pit in which the turn-table is placed. The stop (shown in fig. 5) may be placed at any convenient part of the curb or outer retaining wall of the turn-table pit, or it may be placed near the force or injecting-pump, so that the same person who manages the raising and lowering of the table, may depress the stop when required, by setting his foot upon, or otherwise depressing the foot-plate, G^1, affixed to the top of the spindle, H^1, and thereby overcoming the upward pressure of the helical spring, F, which at all other times either presses the bolt, F^1, into one of the recesses made in the ring, K^1, or causes it to bear up against its lower edge.

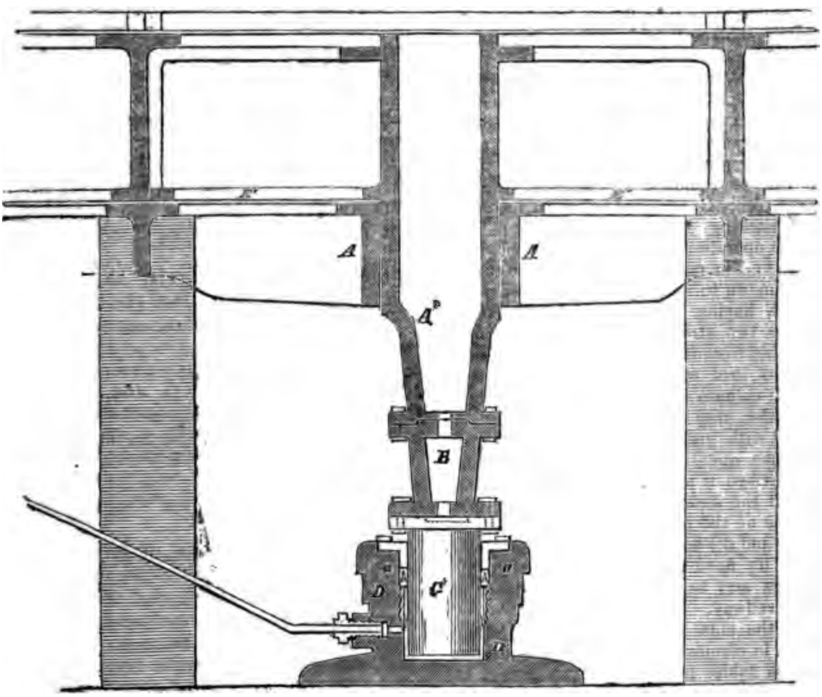
The platform (if raised from its bearings) may now be turned round without interruption until the bolt, F^1, comes under the opening, L^1, in the outer rim of the platform, and the bolt falling into this opening, the further turning of the table will be arrested unless the stop is again depressed. The openings, L^1, in the outer rim, K^1, of the platform must be made at intervals corresponding with the distance through which the table, is to be turned for the purpose of bringing the rails, *r r*, in the platform of the table, opposite the line of rails of the permanent way on to which the carriage is to pass from off the table. The foundation of the walls upon which the platform of the table rests, especially of the walls under the central part of the platform, will require particular attention, and in all cases in which the natural foundation is not of the most solid description concrete should be resorted to, so as to ensure a solid foundation for at least the central part, and to guard as much as possible against settlement in any part, after the table has been fixed and adjusted.

The construction of the force-pump for injecting the water, or fluid, into the raising apparatus requires no explanation; many varieties of force or injecting-pumps, both with and without safety-valves, being in use, and their construction being perfectly understood by engineers. The pump shown in fig. 1 is shown as arranged for working two tables, or two sets of tables, but various other arrangements may be adopted. It will be obvious, too, that one pump may be employed in a station for a great number of tables, by simply turning a cock in connection with the pipe leading to the table to be raised. When room is of great importance, as in stations, the forcing or injecting-pump may be placed in the outer, or even the inner pit of the turn-table, or at any convenient place at a distance.

The adaptation of the raising apparatus to the central shaft admits of several arrangements. According to that shown in fig. 1, the central shaft or pillar, B^1, (to which the platform of the table is firmly attached, as already mentioned,) is fitted with great accuracy, so as to turn freely in an upper and a lower collar, A and B, firmly set in the brickwork of the walls, under the rails already referred to, and accurately adjusted

to each other, so that the central shaft may be vertical. The raising apparatus is placed immediately below the bottom of the shaft, and consists of a short piston, C, fitted into a cylinder, D, having near the upper part a recess for receiving a cup-packing, *a a*, (as in the hydraulic press,) which may be of leather, as usual, or of the metallo-thionised caoutchouc or gutta percha. The axis, or central line of the piston and cylinder of this raising apparatus, should be placed as nearly as possible in accurate adjustment with the axis or central line of the pillar of the table, and the whole apparatus firmly secured in its place. The necessity which may occasionally exist for introducing fresh packing, renders it necessary to provide suitable arrangements for ready access for that purpose. This may be effected in various ways; for instance, supposing the piston to be at the bottom of the cylinder, and consequently not in contact with the central shaft, the raising apparatus may be withdrawn from under the central shaft and the piston raised out of the cylinder, and fresh packing introduced. Instead of the raising apparatus resting on the foundation, (as shown in fig. 1,) it may be suspended from the lower collar by bolts, D^2 D^2 (of sufficient strength to sustain the weight to be raised by the fluid-pressure), and these being withdrawn, the apparatus may be lowered down (a sufficient depth being left for this purpose) and the piston

Fig. 3.



raised out and fresh packing introduced. Or the raising apparatus may be permanently and solidly fixed, but cut across at the middle of the packing, as shown by the dotted line, E E; the two parts of the cylinder being held together by strong bolts, inserted through flanges cast on the upper and lower portions of the cylinder. In this last case, the piston must be of such a length as that when the piston falls to the bottom of the cylinder, the top of the piston may be on a level with the dotted line; the bolts in the flanches being then unscrewed, the top of the cylinder may be lifted off and fresh packing introduced. If the junction of the upper and lower part of the cylinder in the middle of the packing be objected to, the junction may be made at the top of the recess, (as in fig. 7;) for the leather packing instead of at the middle, as indicated by the lines, E E, and the upper part, L, may be made to fit as an external cylinder, or cap, upon the top of the lower part, D.

When instead of having the lower collar, as above described, the raising apparatus is made to answer that purpose by the lower part of the central column or shaft being accurately fitted as a piston or ram to the cylinder, then the cylinder of the raising apparatus must be very firmly secured sideways to the foundations, as it will have to counteract the tendency of the table to tilt when in the act of turning.

In fig. 3, the raising apparatus is secured at the sides by wedges or blocks, which can be removed, and the table being raised to such a height as to take the line, a^1, of division at the lower end of the shaft, clear of the top of the cylinder, the table is to be wedged up, and the piston being allowed to fall to the bottom of the cylinder (the injection-pipe being disconnected) the raising apparatus can be drawn from under the central shaft and fresh packing introduced, as already described.

In fig. 3, the central shaft is made in three pieces, A^2, B, and C, the middle piece being fitted into square apertures, in, and firmly secured by bolts in the flanges to, the upper and lower pieces, so that the middle piece, B, can be removed at pleasure, and the lower piece, C, removed so as to introduce fresh packing.

The operation of turning the table is as follows: The carriage which is to be turned and run on to another line of rails, or reversed, having been run upon the table, one or two strokes of the pump will raise the table from its bearing, $E^1 E^1$; the table with its load will then be sustained by a central column or pillar, resting on a fluid, and (the stop being depressed) may be turned with great facility. The table having come opposite to the rails on to which the carriage is to be run, the extreme pressure of the water will be released by turning one of the handles, $N^1 N^1$, (shown in figs. 1 and 3,) and the table will again sink on to its fixed bearings, $E^1 E^1$, when the carriage may be run off from the table on to the railway.

By the side of the force, or injecting-pump, in connection with the pipe leading to each table, is placed an air-gauge, O, which may be used for several purposes; *firstly*, as soon as the water-level becomes stationary, or the compression of the air ceases, the table will have been raised, and to whatever height the table is raised by the injection of fresh fluid the gauge will remain stationary. Thus the gauge may be employed to facilitate the working of the table. *Secondly*, the gauge may be employed to ascertain the load which is on the table. For this purpose the height at which the water stands when no carriage is on the *table, or when* the weight of the table only is sustained, will be the zero of the scale, and the weight of the table being known, the degree of compression will indicate the weight of the additional load, the pressure-gauge being graduated according to rules, which are well understood. *Thirdly*, the gauge will serve to indicate whether there is an impediment to the lifting of the table besides the mere weight to be raised, inasmuch as if any obstruction exists, the gauge will not attain a stationary position, but the compression will continue beyond the ordinary limits of loads to be lifted. Hence, if from any cause the table is out of working condition the gauge will show it. If there be leakage in the pumps or raising apparatus, the gauge will not stand at a higher level with each stroke of the pump.

The patentee declares, in conclusion, that he does "not claim as new, or the exclusive use of a fluid as a support to a central shaft or column turning upon it, or the apparatus for injecting and retaining fluid under pressure, or the several parts of the table and arrangements shown in the figures, except when such fluid-pressure apparatus parts and arrangements are used for the purposes and in the manner" before described.

GIBBON'S IMPROVEMENTS IN TRUSSING BEAMS AND GIRDERS.

Sir,—The objections to the present system of trussing cast girders would be increased fourfold by the application of Mr. Gibbon's improvement (p. 454.) It is the great elasticity of malleable as compared with cast iron, causing an inequality of action, which renders the tensile truss comparatively useless. Springs would increase this inequality, and consequently the inutility.

It is either from a want of knowledge of the statical conditions of the truss, or it is an error in delineation, that the springs (fig. 2) are represented as pressing transversely on the horizontal tensile bars. A transverse strain under such circumstances is highly objectionable, especially as it is easily avoided by bringing the pressure on the joists.

It is ridiculous to suppose that the tensile bar (fig. 1) would of itself be able to support that weight which had caused rupture when resisted by the united efforts of both bar and girder.

If the girders did break, it would not be at c (fig. 1), unless from some imperfection in the material.

I am, Sir, yours, &c., W.

London, Nov. 8th, 1847.

GEOMETRY OF THE LINE AND PLANE.—BY T. S. DAVIES, F.R.S., L. & E., F.S.A.,
ROYAL MILITARY ACADEMY, WOOLWICH.

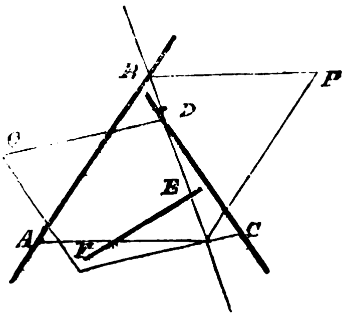
(Continued from p. 388.)

Parallel Lines and Planes.—(Concluded.)

PROP. XXIII.

[This proposition is intended o comprise under one heading several connected properties that are usually kept separate. Those readers to whom the subject is new may pass them over on the first reading; but they are too intimately connected with the foregoing propositions to properly admit of being transposed to another part of this course, and too important to be ommitted altogether.]

(1.) *If any three lines in space be given, no two of which are in the same plane, innumerable straight lines may touch them all three*



Let AB, CD, EF be three lines, no two of which are in the same plane: then through *any point* E in one of them, EF a straight line may be drawn which shall touch AB and CD.

For through AB and E let the plane AP be drawn, and through CD and E the plane CQ. These will intersect in a straight line which passes through E.

Moreover this line is in the plane AP and therefore in the same plane with AB; whence, *generally*, the line through E, in which the planes intersect will touch (that is, meet) AB.

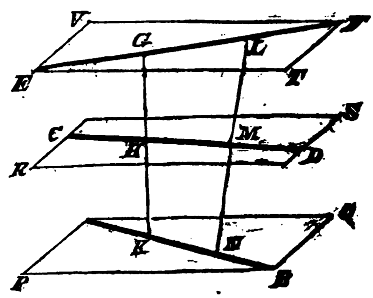
In the same manner it may be proved that the same line will touch CD. Whence one line can be drawn, as stated in the enunciation.

Again, since E is *any point* in EF, the reasoning will equally apply to *every point* in EF without restriction; and hence it follows that innumerable lines can be so drawn.

Scholium.

The case of the line through E being parallel to AB or CD, is included in the idea of an intersection being infinitely remote. Also, had the point E been taken infinitely distant in either direction, the line BDE would have been that of the intersection of two planes through AB and CD, both of which were parallel to EF.

(2.) *If the three straight lines be parallel to the same plane, and no two of them parallel to each other; then all lines resting on them, drawn as in the preceding case, will be divided proportionally.*

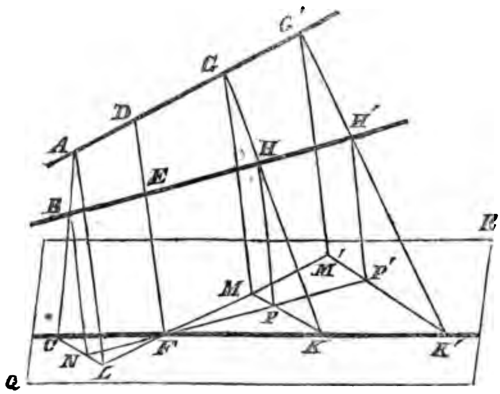


Let the lines AB, CD, EF be parallel to one plane (not exhibited in the figure), and let lines KHG, NML rest upon them: then GH : HK :: LM : MN.

For since AB, CD, EF are parallel to the same plane, planes PQ, RS, TV can be drawn through them parallel to that plane (*props.* 8 and 10.) The lines KHG, NML resting on AB, CD, EF are cut by the planes PQ, RS, TV in the same points as they are cut by the lines; whence GK, LN are cut in G, H, K and L, M, N by parallel planes, and are therefore divided proportionally, (*prop.* 20.) Wherefore,

GH : HK :: LM : MN.

(3.) *If three straight lines be parallel to the same plane, and no two of them in one plane, then all straight lines which rest upon them will divide them at the points of contact proportionally.*



Let AG, BH, CK be parallel to the same plane (not exhibited in the figure), and let any number of lines ABC, DEF, GHK, *etc.*, rest upon them; then

AD : DG :: BE : EH :: CF : FK.

For through CK draw the plane QR parallel to that specified in the enunciation; through A, G, B, H draw lines AL, GM, BN, HP parallel to EF, meeting the plane PQ in L, M, N, P; and join LF, MF, NF, PF.

Then, since AL, BN are parallel to DF, they are parallel to one another (*prop.* 6,) and are hence in one plane; and since A, B are points in the parallels AL, BN, the line AC is in that plane.

Whence the points C, N, L being in the two planes ACL and QR, the points C, N, L are in one straight line, viz., the intersection of the two planes.

In the same way it is proved that M, P, K are in one straight line.

Again, since A, D, G are in one line, and the three lines AL, DF, GM are parallel, they are in one plane; and hence the points L, F, M which are in both planes ALMG and QR are in one line, viz., their intersection. That is, L, F, M are in one straight line.

Since AL, GM are parallel, and drawn from points A, G in AG, and since AG is parallel to the plane PQ, the lines AD, LM are equal and parallel. In like manner NP is equal and parallel to BH. Also, since DF is parallel to AL and GM we have AD=LF and DG=FM; and similarly, NF=BE and FP=EH.

Now parallels, and (2) of this we have

CN : NL :: CB : CA :: KH : HG :: KP : PM;

and hence CL is parallel to MK.

Wherefore CF : FK :: NF : FP :: LF : FM :

Or, CF : FK :: BE : EH :: AD : DG.

In the same maaner it may be proved for any number of lines analogous to AC, DF, GK; as, for instance, G′H′K′.

(4.) *If three lines be parallel to a plane, and no two of them in one plane, all the lines which can be drawn to rest upon them will be parallel to one plane.*

(*Preceding Figure.*)

Let AG, BH, CK be three lines all of which are parallel to one plane, (not ex-

ibited in the figure) and no two of them in the same plane: then if lines ABC,)EF, GHK rest upon them, all these lines will be parallel to another plane.

For since AC, CL are respectively parallel to AM, MK, (*preceding case*) the lane GMK is parallel to the plane ACL (*prop.* 7); and hence GK situated in the lane MGK can never meet the plane ACL. In other words, GK is parallel to any lane which is drawn parallel to AC and DF.

In the same way the property is proved to hold true for any other line, as Y'H'K' which rests upon the three given lines AG, BH, CK.

5.) *Let any three straight lines, no two of which are in the same plane have three others resting upon them; and let two lines of either series be divided in the same ratio by the other series; then will all three lines of that series be divided in the same ratio, and likewise the three of the other series in the same ratio; and each series will lie in parallel planes.*

These follow as corollaries of the preceding and need no formal demonstration.

The following also is easily deducible from the same kind of reasoning modified) suit the case:

3.) *Let there be a quadrilateral figure whose sides are not all in one plane; and let each pair of opposite sides be similarly divided: then the lines joining the opposite points of division will be in the same plane; the lines joining the adjacent points of division will meet in the diagonals of the quadrilateral, one pair in one diagonal, the other in the other; the lines themselves will be divided at their point of mutual section in the same ratio as the opposite pair of sides which they do not respectively meet; and the three lines of each series will be in parallel planes.*

[The next Chapter will commence the properties of *Perpendicular Lines and Planes.*]

A PLUS AND MINUS PUZZLE.

Sir,—I am induced to appeal to you)y a circumstance of a most perplexing, [may say, alarming character; for if the :rain of reasoning to which I have been)bliged to succumb, were in more general ise, the mischief that might ensue to :hat most useful body of men, the money-.enders, would be incalculable.

About a month ago, I advanced in a weak moment the sum of thirty shillings to an ingenious friend, who, on my mak-ng application to him yesterday for the amount, tendered me half-a-sovereign, :oolly assuring me that that was all he owed me, and that he was prepared to prove it.

At this announcement I was,—to use an expressive phrase,—"struck all of a heap;" but my friend, producing his pocket-book, went on to say, "Have the kindness to attend. I know you pride yourself on your mathematical acquire-ments, and I am therefore confident you will listen to reason. Now, we will call a sovereign A, and a half-sovereign B. You assert that you have lent me $A+B$, and I have now returned you $A-B$; if I prove to you that these sums are equal, I am sure you will be satisfied." To such a reasonable proposal I, of course, assented.

He continued: "Since

$$A=2B \quad \therefore \quad AB=2B^2$$
$$\text{and } AB+AB=2B^2+2B^2$$
$$\therefore \text{ by transposition } AB-2B^2=-AB+2B^2$$

Now, by adding A^2-2AB to each side of the equation, you will have

$$A^2-AB-2B^2=A^2-3AB+2B^2$$

Divide each side by $A-2B$ and you will find that

$$A+B=A-B;$$

or that a sovereign and a half is no more than a sovereign minus a half, which is the sum I gave you; so I hope I shall hear no more about the matter."

I rather demurred to all this, but he produced, from what he assured me was a Text-book at Cambridge—*The Facetiæ Cantabrigienses*—(an odd title I thought for a scientific work, but one does see odd titles), the following equation:

$$
\begin{array}{ll}
\text{Let } x=1 & \\
\text{and } y=1 & \\
\text{then } x=y \text{ and } x^2=xy & \text{take from each } y^2 \\
\qquad x^2-y^2=xy-y^2 & \text{divide each by } x-y \\
\qquad x+y=y & \\
\quad \text{or } 1+1=1 &
\end{array}
$$

This seemed so similar a case, that I began to reflect with the Vicar of Wakefield, that the number of witnesses was a strong presumption they were right, and that St. Gregory upon Good Works professes himself to be of the same opinion; so, being unable to discover any error in my friend's calculation, and as doubting the correctness of the result might destroy my mathematical reputation, I was fain to depart with my half-sovereign, vowing inwardly never to lend money again.

Could you, Sir, or any of your correspondents point out the fallacy that has thus lightened my pocket? I cannot help thinking it consists in constructing an equation, both sides of which $=0$; but which, on being divided by another good-for-nothing expression, produces different quotients: and at the same time I must express my opinion, that it is disgraceful on the part of algebra to suffer such a thing to be possible.

I am, Sir, yours &c.,

J. E.

BOURNE'S CATECHISM OF THE STEAM-ENGINE.*

"The present work," says the author, "is not intended as a substitute for the quarto treatise on the Steam-engine which I lately published, but is rather to be regarded as an introduction, and in some measure also as a supplement to that work. The mode of publication of the quarto treatise rendered faults of arrangement inevitable that need not exist in the present undertaking, and it appears to me that a work upon the steam-engine, which in a moderate compass should give an outline of the whole subject on its practical aspect would still be of much utility."

The "quarto treatise" to which Mr. Bourne alludes, is the treatise "by the Artizan Club," of the earlier numbers of which we have a recollection of having had occasion to speak in terms of some severity. The appearance of the present sequel has brought to mind also an unfulfilled promise to pay our respects to the entire work, when completed. The reason of our not doing so it may now be as well to state. With the last of the work there came out a preface, (which like all *pre*-faces was a veritable *post*-script) in which the author acknowledged so frankly and ingenuously the principal deficiencies of his performance, as entirely to disarm criticism. It left no more to be said. We think Mr. Bourne has now acted somewhat unwisely in recalling attention so pointedly to that ponderous jumble. It would be a great pity were the present "Catechism" a thing which could only be used as an "introduction," or a "supplement" to the "Treatise." The octavo is in every way so vastly superior to the quarto as to make companionship out of the question. The dozen men rolled into one (of whom Mr. Bourne erewhile affected to be the impersonation, on the modest theory, we suppose, that a person equal to the production of such a prodigy of genius as the "Treatise," must himself be a twelve-headed prodigy at least,) are nothing to the one man in his own proper person. Neither, we are glad to say, is there any necessary connection between the two works. All that is requisite to enable any one to avail himself to the fullest extent of the information in the "Catechism," is a knowledge of the mechanical construction of the steam-engine; and that is to be obtained quite as well from other works as the "Treatise"—from most of them much better. We do not like the question and answer, or Prigg and Harris' style, which Mr. Bourne has adopted in this instance, any more than we liked his "Club" fiction, and could

* A Catechism of the Steam Engine. By John Bourne, C.E., 8vo., p. 276. Williams and Co., 1847.

were cured of all such affectations; m it, too, a considerable defect in 'atechism," that it is entirely destigraphic illustration—containing not plate, or woodcut; but passing these ns over—which are objections touchmanner, more than the matter of the we are happy to be able to bestow ; nearly unqualified praise. It is a ook, yet of priceless value to all enkers and engine-users; containing amount of practical information on ject of the steam-engine, such as is et with nowhere else, not even in a d and scattered shape. The informao, is given with great fulness, clearid distinctness. The author does not arry you along with him in his conclund is dogmatical at times; but he if ever, gives you any reason to doubt to be just and impartial. Everything, er, is to the point; no idle digresto empty declamation—none of that h sentimentalism which was so disin the "Treatise," and is so disgustrywhere.

iave only room at present for a single n; and though we might readily exbetter, we prefer this one, on account vidence which it furnishes, that the phical genius which presided over ablishment of the Soho Works, has pired with their illustrious founder:

t of the Lines of Steam-vessels on their Speed.

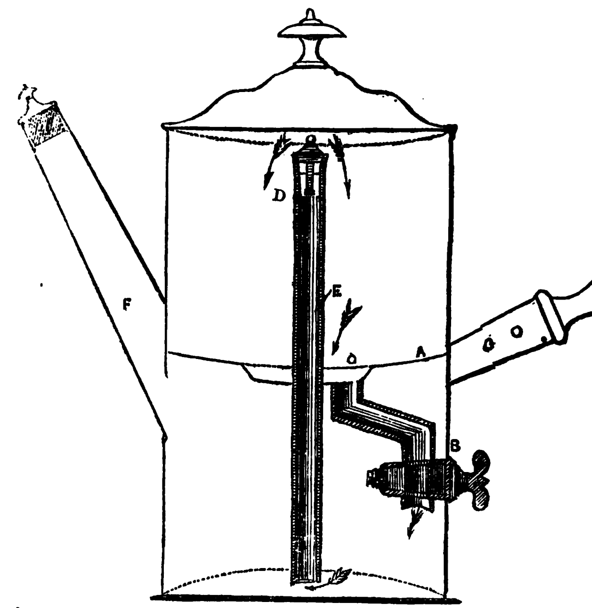
.—But may not the different shapes lassified that the speed answerable to power in a specified class can be imately predicted?

—Yes, that may be done, and *has* one, by Boulton and Watt, who have ined, experimentally, the speed realizifferent forms of vessels with different of engine, and have deduced from rules which enable them to tell with precision the speed which any new of a particular form and power, will . The first set of experiments was in 1828, upon the vessels *Caledonia*, *Eclipse*, *Kingshead*, *Moordyke*, and ; vessels of a similar form and all with bilges and flat floors; and the result establish the number 925 as the cot of performance of such vessels. This co-efficient is obtained by multiplying the cube of the velocity of the vessel in miles per hour by the sectional area of immersed midship-section in square feet, and dividing by the nominal horse power; and its use is to enable us to determine the speed of any similar vessel with any other area of midship section, and any other number of nominal horse power. The better the shape of the vessel is, the larger the co-efficient becomes, as appears by the second set of experiments, which were made upon the superior vessels *Venus*, *Swiftsure*, *Dasher*, *Arrow*, *Spitfire*, *Fury*, *Albion*, *Queen*, *Dart*, *Hawk*, *Margaret*, and *Hero* —all vessels having flat floors and round bilges, where the co-efficient became 1,160. The third set of experiments was made upon the vessels *Lightning*, *Meteor*, *James Watt*, *Cinderella*, *Navy Meteor*, *Crocodile*, *Water-sprite*, *Thetis*, *Dolphin*, *Wizard*, *Escape*, and *Dragon*—all vessels with rising floors and round bilges, and the co-efficient of performance was found to be 1,430. The fourth set of experiments was made in 1834, upon the vessels *Magnet*, *Dart*, *Eclipse*, *Flamer*, *Firefly*, *Ferret*, and *Monarch*, when the co-efficient of performance was found to be 1,580. The velocity of any of these vessels, with any power or sectional area, may be ascertained by multiplying the co-efficient of its class by the nominal horse power, dividing by the sectional area in square feet, and extracting the cube root of the quotient, which will be the velocity in miles per hour; or the number of nominal horse power requisite for the accomplishment of any required speed may be ascertained by multiplying the cube of the required velocity in miles per hour, by the sectional area in square feet, and dividing by the co-efficient; the quotient is the number of nominal horse power requisite to realize the speed. In the whole of these experiments the pressure of steam in the boiler varied between 2¾lbs. and 4lbs. per square inch, and the effective pressure on the piston varied between 11lbs. and 13lbs. per square inch, so that the average ratio of the nominal to the actual power may be easily computed; but it will be preferable to state the nominal power of some of the vessels, and their actual power as ascertained by experiment. Of the *Eclipse*, the nominal power was 76, and the actual power 144.4 horses; of the *Arrow*, the nominal power was 60, and the actual 119.5; *Spitfire*, nominal 40, actual 64; *Fury*, nominal 40, actual 65.6; *Albion*, nominal 80, actual 135.4; *Dart*, nominal 100, actual 152.4; *Hawk*, nominal 40, actual 73; *Hero*, nominal 100, actual 171.4; *Meteor*, nominal 100, actual 160; *James Watt*, nominal 120, ac-

tual 204; *Watersprite*, nominal 76, actual 157.6; *Dolphin*, nominal 140, actual 238; *Dragon*, nominal 80, actual 131; *Magnet*, nominal 140, actual 238; *Dart*, nominal 120, actual 237; *Flamer*, nominal 120, actual 234; *Firefly*, nominal 52, actual 86.6; *Ferret*, nominal 52, actual 88; *Monarch*, nominal 200, actual 378. In the case of swift vessels of modern construction, such as the *Red Rover*, *Herne*, *Queen*, and *Prince of Wales*, the co-efficient appears to be about 2,550; but in these vessels there is a still greater excess of the actual over the nominal power than in the case of the vessels previously enumerated, and the increase in the co-efficient is consequent upon the increased pressure of the steam in the boiler, as well as the superior form of the ship. The nominal power of the *Red Rover*, *Herne*, and *City of Canterbury* is, in each case, 60 horses, but the actual power of the *Red Rover* is 147, of the *Herne* 177, and of the *City of Canterbury* 153, and in some vessels the excess is still greater; so that with such variations it becomes necessary to adopt a co-efficient derived from the introduction of the actual instead of the nominal power. In the first class of vessels experimented upon, the actual power was about 1.6 times greater than the nominal power; in the second class, 1.67 times greater; in the third class, 1.7 times greater; and in the fourth, 1.96 times greater; while in such vessels as the *Red Rover* and *City of Canterbury* it is 2.65 times greater, so that if we adopt the actual instead of the nominal power in fixing the co-efficients, we shall have 554 as the first co-efficient, 694 as the second, 832 for the third, and 806 for the fourth, instead of 925, 1,160, 1,430, and 1,580 as previously specified; while for such vessels as the *Red Rover*, *Herne*, *Queen*, and *Prince of Wales*, we shall have 962 instead of 2,550. These smaller co-efficients then express the relative merits of the different vessels without reference to any difference of efficacy in the engines, and it appears preferable, with such a variable excess of the actual over the nominal power, to employ them instead of those first referred to. From the circumstance of the third of the new co-efficients being greater than the fourth, it appears that the superior result in the fourth set of experiments arose altogether from a greater excess of the actual over the nominal power."

WALLER'S PATENT COFFEE-POT.

[Patent dated February 16, 1847. Specification enrolled August 16, 1847.]



This invention consists of a vessel divided horizontally into two equal parts by a solid partition or diaphragm, A, which partition is stamped like a dinner-

with a broad rim, the central de-
:ed portion being pierced by a hole,
ıd the edge of which is attached a
tube, connected to a tap, B; by
h arrangement a passage or way
be opened or shut off, at pleasure,
the upper to the lower half of the
l. Around the margin of the dished
of the diaphragm is soldered a
ıer, C, of very finely perforated
l. E is a vertical pipe, reaching from
n a short space of the bottom of the
: chamber to nearly the top of the
r one, passing through the dia-
ʒm and perforated plate, to both of
h it is firmly soldered. In the top
is tube there is a valve, D. F, is an
ary spout with a cork plug, or stop-
which fits it so tightly as to render
en necessary air-tight. G, is a com-
handle.

ıe mode of using the pot is as fol-
:—The tap at the side being closed,
the cork or stopper removed from
pout, you pour the requisite quan-
f water, hot or cold, into the upper
of the vessel; you then turn the tap
wards, when the water will run into
ower half, upon which, put in the
ıd coffee on the strainer, C, taking
that none of it lodges on the top
, D; you next replace the cork or
er, turn the tap again horizontally,
lace the pot on the fire. The water
y the pressure of the steam, soon
d up the central tube, and falls at
:quired temperature *upon the coffee.*
· a few seconds, take the vessel off,
.way from the fire, and allow it to
about three minutes. You then
the tap downwards, when the in-
n will, by the pressure of the atmo-
·e upon the vacuum in the lower
ber, rapidly filter into it, and be at
ready for use, in a beautifully bright
oiling condition, leaving the grounds
lry and hardened state.

will be readily seen that the valve
:nts the air from re-entering the
· chamber, after its total expulsion
:e by the creation and subsequent
:nsation of steam. An almost per-
vacuum is thus preserved for any
red period, and rendered available
fecting rapid filtration whenever it
be desired, by simply turning the
and thereby opening the way be-
ı the filtering-grate and the vacuum
ber below.

The advantages that may be fairly claimed for his apparatus are these: In the first place, it consists but of one thing, having not a single detached portion, save the cork or stopper; it requires no taking to pieces, no screwing or unscrewing of parts, no putting in and taking out of filtering-grates, or flannel-bags, or other troublesome appliances; neither does it involve any complicated machinery, neither wheels, nor pistons, nor pumps, nor anything of the sort. Again; no exertion is required in using it, and with common care it cannot get out of order. By simply rinsing it out occasionally, it will always be clean and fit for use. Moreover, the whole process of making the coffee being conducted in a closed vessel, not a particle of its aromatic flavour can be dissipated. The infusion is of an exceedingly rich, fresh, and fragrant quality, very different from the thick, rancid, and heating liquid produced by the pernicious practice of boiling or long infusing. The water in this apparatus does not come in contact with the coffee till it has acquired the proper temperature; consequently the infusion must be hot. And, finally, the steam which escapes gives notice by its action on the valve of the necessity for removing the vessel from the fire (making its exit *over* the infusion, and *not through* it), and thus serves as a medium of protection and entirely prevents any loss from evaporation. Should any coffee be left unexhausted, it may be easily preserved from the air and heated again in the same vessel.

As in this apparatus the vacuum admits of being preserved for any length of time, it may obviously be applied with great advantage by chemists, druggists, and medical men, for preparing and filtering their infusions, tinctures, mixtures, &c.,—a process now exceedingly tedious and troublesome, especially when it is desired to filter very fine liquids.

FIELD'S EBULLITION ALCOHOLMETER. BY ANDREW URE, M.D., F.R.S., ETC.

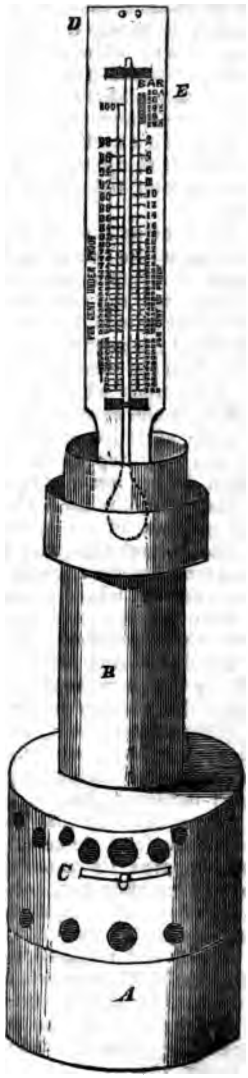
[From the *Pharmaceutical Journal* for October, 1847.]

That the boiling temperature of water is increased by holding neutro-saline and saccharine substances in solution has been long known, and has been the subject of many experiments, made partly with the view of ascertaining from that temperature the pro-

portion of the salt or sugar, and partly with the view of obtaining a practical liquid bath. But it seems to have been reserved for the Abbé Brossard-Vidal, of Toulon, to have discovered that the boiling temperature of alcoholic liquors is, in most cases, proportional to the quantity of alcohol, irrespectively of the quantity of neutro-saline or saccharine matter dissolved in them. When, however, such a quantity of dry carbonate of potash, or sugar, is added to a spirituous liquor as to abstract or fix in the solid state a portion of the water present, then the boiling temperature of that mixture will be lowered in proportion to the concentration of the alcohol, instead of being raised, as would be the case with water so mixed. But, generally speaking, it may be assumed as a fact, that the boiling point of an alcoholic liquor is not altered by a moderate addition of saline, saccharine, or extractive matter. On this principle, M. Brossard-Vidal constructed an instrument for determining by that temperature the proportion of alcohol present. His chief object was to furnish the Revenue Boards of France with a means of estimating directly the proportion of alcohol in wines, so as to detect the too common practice of introducing brandy into their cities and towns under the mask of wine, and thereby committing a fraud upon the *octroi*; as the duty on spirits is much higher than on wines.

The instrument consists of a spirit-lamp, surmounted by a small boiler, into which a large cylindric glass bulb is plunged, having an upright stem of such calibre, that the quicksilver contained in them, may, by its expansion and ascent when heated, raise before it a little glass float in the stem, which is connected by a thread with a similar glass bead, that hangs in the air. The thread passes round a pulley, which turning with the motion of the beads, causes the index to move along the graduated circular scale. The numbers on this scale represent per centages of absolute alcohol, so that the number opposite to which the index stops, when the liquor in the cylinder over the lamp boils briskly, denotes the per centage of alcohol in it.

Such was the instrument when it was placed in my hands some months ago by Mr. Field, who had obtained a patent in this country for determining thereby the strength of spirituous liquors. I made a great many experiments on the boiling points of alcohol at various successive degrees of watery dilution, and verified the general utility of the contrivance, but I found the construction of the instrument subject to several defects. The mass of mercury to be heated in the large bulb was so great as to occasion some loss of alco in the course of the experiment; the len of the thread was liable to be affected the moisture of the air, it occasion failed to move the pulley with sufficient d cacy on account of friction, and when spirit in the lamp got heated in its case flared up and burned the thread, thus r dering the apparatus useless till a fr thread was experimentally adjusted to beads.



hese accounts I renounced the com-
n of M. Vidal, and adopted the
mple and direct form of indication
ated in the figure :
, of a spirit-lamp, A, surrounded by
r for containing cold water to keep
ip cool, should many experiments
to be made in succession; and,
of the boiler, B, which fits by its
cage, C′, on the case of the lamp.
point C, is seen the edge of the
-plate for modifying the flame of the
r extinguishing it when the experiment is completed. D, is the thermometer made with a very minute bore, in the manner of the Rev. Mr. Wollaston's instrument for measuring the height of a mountain by the boiling point of water on its summit. The bottom of the scale in the ebullition thermometer is marked P, for proof, on the left side, and 100 (proof spirit) on the right side. It corresponds to 178.6 Fahr. nearly, or the boiling point of alcohol of 0.920, specific gravity. The following table gives the boiling points corresponding to the specific gravities.

Temp. Fahr.	Specific Gravity.		Temp. Fahr.	Specific Gravity.	
178.5	0.9200	P.	185.6	0.9665	50 U.P.
179.75	0.7321	10 U.P.	189.0	0.9729	60 ,,
180.4	0.9420	20 ,,	191.80	0.9786	70 ,,
182.01	0.9516	30 ,,	196.4	0.9850	80 ,,
183.40	0.960	40 ,,	202.0	0.992	90 ,,

above table is the mean of a great
xperiments. When alcohol is stronger
92, or the excise-proof, its boiling
ries too little with its progressive
of strength, to render that test
le in practice. In fact, even for
pirits, or spirits approaching in
to proof, a more exact indication
obtained by diluting them with their
k of water, before ascertaining their
, and then doubling it.

oiling point of any alcoholic liquor
rise if the heat be long continued,
reby to lead into error in using this
ent. This source of fallacy may be
at measure avoided by adding to the
n the little boiler about a teaspoon-
grains) of common culinary salt,
as the curious effect of arresting the
r in the thermometer at the true
point of the spirit, wine, or beer, to
correct reading to be had.

hermometer is at first adjusted to an
eric pressure of 29.5 inches. When
sure is higher or lower, both water
ohol boil at a somewhat higher or
mperature. In order to correct the
ich would hence arise in the indica-
his instrument under different states
weather, a barometrical equation is
l by means of a subsidiary scale, E,
hermometer, D.

g stated the principles and the con-
n of the ebullition alcoholmeter,
now describe the mode of its appli-

, Light the spirit-lamp, A.

d, Charge the boiling vessel, B,
e liquid to be tested (to within an
the top), introducing at the same
aper of the powder; then place the
B, (the damper-plate being with-
on the lamp, A.

Third, Fix the thermometer, D, on the stem attached to B, with its bulb immersed in the liquid. The process will then be in operation.

The barometrical scale indicated on the thermometer, is opposite the mean boiling point of water. Prior to commencing operations for the day, charge the boiler, B, with water only, and fix the instrument as directed; when the water boils freely the mercury will become stationary in the stem of the thermometer, opposite to the true barometrical indication at the time. Should the mercury stand at the line 29.5, this will be the height of the barometer, and no correction will be required; but should it stand at any other line, above or below, then the various boiling points will bear reference to that boiling point.

In testing spirituous, or fermented liquors of any kind, when the mercury begins to rise out of the bulb of the thermometer into the stem, push the damper-plate halfway in its groove to moderate the heat of the flame. When the liquor boils freely, the mercury will become stationary in the stem; and opposite to its indication, on the left, the under-proof per centage of spirit may be read off at once, if the barometer stands that day at 29.5 inches; while on the right-hand scale, the per centage of proof spirit is shown; being the difference of the former number from 100. The damper-plate is to be immediately pushed home to extinguish the flame.

The alcoholmeter will by itself only indicate the per centage or alcohol contained in any wine; but by the aid of the hydrometer, the proportionate quantity of saccharum in all wines may be readily and easily determined. The hydrometer will show the specific gravity of the liquid upon reference

to table (No. 1,) annexed. In testing a sample of wine, first take the specific gravity, and suppose it to be 989, then charge the boiler of the alcoholmeter with the wine, as directed, and at the boiling-point it indicates the presence of alcohol at 69.6 per cent.^{up}, whose specific gravity will be found to be 979; deduct that gravity from the gravity of the bulk, or 989, and 10 will remain, which 10 degrees of gravity, upon reference to the wine table, will be found to represent 25 lbs. of saccharine or extractive matter in every 100 gallons, combined with 30$\frac{4}{10}$th the gallons of proof spirit.

Sikes's hydrometer will only show the specific gravity of liquids lighter than water (or 1000) and for wines in general use, their gravities being lighter than that article, will answer every purpose; but there are wines whose gravities are heavier than water, such as mountain, tent, rich Malagas, lachrymæ Christi, &c., to enbrace which additional weights to the hydrometer will be required, as for cordialised spirits, &c. In testing a sample of rich mountain, its S.G. was found to be 1039, or 39 degrees heavier than water, that wine at the boiling point indicated the alcohol at 72.5 per cent.^{up}; but 980 S.G. deducted from 1039, leaves 59 degrees of S.G.; against 59 of the wine tables will be found 147-5 or 147½ lbs. of saccharine or extractive matter combined with 27½ gallons of proof spirit to every 100 gallons.

Should the barometer for the day show any other indication above or below the standard of 29.5, the thermometer scale will then only show the apparent strength, and reference must be had to the small ivory indicator, E, it being the counterpart of the barometrical scale of the thermometer, thus —should the barometer indicate 30, place 30 of the indicator against the boiling point of the liquid, and opposite the line of 29.5 will be found the true strength.

Example 1.—Barometer at 30.—Suppose the mercury to stop at the boiling-point 72-^{up}, place 30 of the indicator against 72 on the thermometer, and the line of 29.5 will cut 69.6-^{up}, the true strength.

Example 2.—Barometer at 29.—Suppose the mercury to stop at the same point, 72-^{up}, place 29 of the indicator against 72 on the thermometer, and the line of 29.5 will cut 74.3-^{up}, the true strength.

For Malted Liquors.

To all brewers and dealers in fermented liquors, this principle, by its application, will supply a great desideratum, as it will not only show the alcohol created in the wort by the attenuation, as well as the original weight of the wort prior to fermentation, but it will indicate the value of malt liquors in relation to their component parts. It will likewise be a ready means of testing the relative value of worts from sugar compared with grain, as well as being a guide to the condition of stock beers and ales.

To ascertain the strength of malt liquors and their respective values, the instrument has been supplied with a glass saccharometer, testing-glass, and slide-rule. Commence by charging the testing-glass with the liquid, then insert the saccharometer, to ascertain its present gravity or density per barrel, and at whatever number it floats that will indicate the number of pounds per barrel heavier than water.

Example 1.—Suppose the saccharometer to float at the figure 8, that would indicate 8 lbs. per barrel; then submit the liquid to the boiling test, with the salt as before directed, and suppose it should show (the barometrical differences being accounted for) 90-^{up}, that would be equivalent to 10 per cent. of proof alcohol. Refer to the slide-rule, and place A on the slide against 10 on the upper line of figures, and facing B on the lower line will be 18, thus showing that 18 lbs. per barrel have been decomposed to constitute that per centage of spirit; then, by adding the 18 lbs. to the present 8 lbs. per barrel, the result will be 26 lbs., the original weight of the wort after leaving the copper.

Example 2.—The saccharometer marks 10 lbs. per barrel, and at the boiling-point it indicates 88-^{up}, equivalent to 12 gallons of proof spirit per cent.; place A against 12, and opposite B will be 21¼ lbs. per barrel, when, by adding that to the 10 lbs. present, 31¼ lbs. will be the result.

To Ascertain the Relative Value.

Suppose the price of the 26 lbs. beer to be 36s. per barrel, and the 31 lbs. beer to be 40s. per barrel, to ascertain which beer will be the cheapest, place 26 on the opposite side of the rule against 36, and opposite 31¼ lbs. will be 43s. 7d.; showing that the latter beer is the cheapest by 3s. 7d. per barrel.

By taking an account of the malt liquors by this instrument prior to stocking, it may be ascertained at any time whether any alteration has taken place in their condition, either by an increase of spirit by after fermentation and consequent loss of saccharum, or whether, by an apparent loss of both, acetous fermentation has not been going on towards the ultimate loss of the whole.

This instrument will likewise truly indi-

cate the quantity of spirit per cent. created in distillers' worts, whether in process of fermentation or ready for the still, the only difference will be in the allowances on the slide-rule.

N.B.—The saccharometers applicable to the foregoing rules for beers, ales, &c., have been adjusted at the temperature 60 Fahr., and will be found correct for general purposes; but where extreme minuteness is required, the variation of temperature must be taken into account, therefore for every 10 degrees of temperature above 60, three-tenths of a pound must be added to the gross amount found by the slide-rule; on the contrary, for every 10 degrees below 60, three-tenths of a pound must be deducted.

For Cordialized Spirits.

The operation in this instance is somewhat different from that of beers, which have the alcohol created in the original worts; whereas, in cordialized spirits, gins, &c., the alcohol is the original, and the saccharine matter, or sugar, is an addendum.

If 100 gallons of spirits are required at a given strength, (say 50 per cent. under proof,) 50 gallons of proof spirit, with the addition of 50 gallons of water, would effect that object, and upon testing it by the alcoholmeter, it would be found as correct as by the hydrometer. But in cordializing spirits it is different, for to the 50 gallons of proof spirit 50 gallons of sugar and water would be added, thereby rendering the hydrometer useless, except for taking the specific gravity of the bulk, and, according to the quantity of sugar present, so a relative quantity of water must have been displaced; and as the sugar has no reducing properties, the alcoholmeter will only show the strength of the cordial in relation to the water contained in it, as the principle indicates, irrespectively of saccharine or extractive matter present.

Suppose, in making 100 gallons of cordial at 50-up, 3 lbs. of sugar are put to the gallon, or 300 lbs. to the 100 gallons, that 300 lbs. displacing $18\frac{67}{100}$th gallons of water, only $31\frac{33}{100}$th gallons of water instead of 50 have been applied; the sugar, without reducing properties, making up the bulk of 100 gallons, which is meant to represent 50 per cent. up.

The alcoholmeter will only show at the full point of ebullition the alcoholic strength in relation to the water in the 100 gallons of the mixture, or 35 per cent. up, leaving 15 per cent. to be accounted for on the bulk.

As the quantity of sugar present must be determined before that per centage can be arrived at, a double object will be effected by so doing, namely, eliciting in all instances the quantity of sugar present, as well as the per centage of spirit to be accounted for.

Example 1.—In taking the S.G. of a cordial, suppose it to be found 1076, then submit the liquid to the boiling point, and having ascertained the per centage of alcohol, and it proves to be 35-up, the S.G. of alcohol at that strength will be found to be 956; deduct 956 from the S.G. of the bulk, or 1076, and 120 will remain; refer that to its amount on the head line of table, No. 2, namely 120, under which will be found 3, representing 3 lbs. of sugar to the gallon; and by running the eye down its column to opposite the alcoholic strength indicated (35-up) will be found 14.9, which represents the per centage of water displaced by the sugar, and which amount of 14.9, added to the 35 per cent. ascertained, makes the total upon the bulk 49.9 per cent. up, with 3 lbs. of sugar to the gallon.

For Gins, &c.

Example 3.—In taking the S.G., suppose it to be found 957; then submit to the boiling point, and it proves to be 14-up, whose S.G. is 937, which deducted from 957, leaves S.G. 20; on the head line of table, No. 2, under 20, will be found ½, or ½ lb. of sugar to the gallon, and on running the eye down to opposite 14-up, will be found 3.0, which added to the 14, makes the total on the bulk 17 per cent. up, with 50 lbs. of sugar to the 100 gallons.

To chemists for their tinctures, &c., this instrument will be found essentially useful.

N.B.—Care must be taken that the mercury is entirely in the bulb of the thermometer before it is fixed on the stem for operation, and in all cases (except for water) the salt must be used.

Conclusion.

Wines are peculiarly subject to be mystified by adulterations of various kinds. It will prove of great advantage to the public when the relative quantity of fruit, or *saccharum*, and alcohol requisite to constitute the normal wine of each species is well ascertained.

Some beers possess a remarkable narcotic power by which they cause drowsiness and stupor without corresponding previous exhilaration. Such beverages may be justly suspected of having been sophisticated with *cocculus indicus*, opium, or some analogous drug; and this suspicion may become certainty, if they be shown by the alcoholmeter to contain only a few per cents. of fermented spirit.

No. 1.

TABLE OF SPECIFIC GRAVITIES by SIKES's Hydrometer, adapted to FIELD's Patent Alcoholmeter for Cordialized Spirits.

TEMPERATURE 60° SPECIFIC GRAVITY OF WATER 1,000°.

60		70		80		90		100		110		120		130		140		150		160		170		180	
Wt.	S.G.	Wt.	S.G.	Wt.	S.G.	Wt.	S.G.	Wt.	S.G.	Wt.	S.G.	Wt.	S.G.	Wt.	S.G.	Wt.	S.G.	Wt.	S.G.	Wt.	S.G.	Wt.	S.G.	Wt.	S.G.
60	922	70	942	80	961	90	981	100	1000	110	1020	120	1041	130	1063	140	1085	150	1107	160	1129	170	1152	180	1175
1	924	1	943	1	963	1	983	1	1002	1	1022	1	1044	1	1065	1	1087	1	1109	1	1131	1	1155	1	1178
2	926	2	945	2	965	2	985	2	1004	2	1024	2	1046	2	1067	2	1089	2	1111	2	1134	2	1157	2	1180
3	928	3	947	3	967	3	987	3	1006	3	1026	3	1048	3	1069	3	1091	3	1113	3	1136	3	1159	3	1182
4	930	4	949	4	969	4	989	4	1008	4	1029	4	1050	4	1071	4	1093	4	1116	4	1139	4	1162	4	1185
5	932	5	951	5	971	5	991	5	1010	5	1031	5	1052	5	1074	5	1096	5	1118	5	1141	5	1164	5	1187
6	934	6	953	6	973	6	993	6	1012	6	1033	6	1054	6	1076	6	1098	6	1120	6	1143	6	1166	6	1189
7	936	7	955	7	975	7	995	7	1014	7	1035	7	1056	7	1078	7	1100	7	1123	7	1145	7	1168	7	1191
8	938	8	957	8	977	8	997	8	1016	8	1037	8	1058	8	1080	8	1102	8	1125	8	1148	8	1171	8	1194
9	940	9	959	9	979	9	999	9	1018	9	1039	9	1061	9	1082	9	1104	9	1127	9	1150	9	1173	9	1196
10	942	10	961	10	981	10	1000	10	1020	10	1041	10	1063	10	1085	10	1107	10	1129	10	1152	19	1175	10	1199

The foregoing Table, which shows the Specific Gravity on the bulk of the mixture, bear reference to the Table (No. 2) of the Alcoholmeter following.

No. 2.

TABLE, showing the lbs. of Sugar per Gallon in Cordialized Spirits, with per Centages to be added to the indicated Strength, per the Alcoholmeter.

Difference of Gravity. lbs. of Sugar per Gallon.		10	15	20	25	30	35	40	45	50	Difference of Gravity. lbs. of Sugar per Gallon.	
		4 oz. or 25 to 100	6 oz. 37½ to 100	8 oz. 50 to 100	10 oz. 62½ to 100	12 oz. 75 to 100	14 oz. 87½ to 100	1.0	oz. 1. 2	oz. 1.4		
Sp. Grav of Spirit.	Per Cent of Spirit.										Per Cent of Spirit.	Sp. Grav of Spirit.
920	Pf.	1.6	2.5	3.4	4.4	5.3	6.2	7.1	8.1	9.0	Pf.	920
923	2.5	1.6	2.5	3.3	4.3	5.2	6.1	6.9	7.8	8.8	2.5	923
926	5.	1.5	2.4	3.2	4.2	5.0	5.9	6.8	7.7	8.6	5.	926
929	7.5	1.5	2.3	3.2	4.1	4.9	5 8	6.6	7.5	8.4	7.5	929
932	10.	1.4	2.2	3.1	4.0	4.8	5.7	6.5	7.4	8.2	10.	932
935	12.5	1.4	2.2	3.1	3.9	4.7	5.5	6.3	7.2	8.0	12.5	935
938	15.	1.4	2.1	3.0	3.8	4.6	5.4	6.2	7.0	7.8	15.	938
940	17.5	1.3	2.1	2.9	3.7	4.5	5.3	6.0	6.8	7.6	17.5	940
943	20.	1.3	2.0	2.8	3.6	4.4	5.2	5.9	6.7	7.5	20.	943
945	22:5	1.3	2.0	2.7	3.5	4.3	5.0	5.7	6.5	7.3	22.5	945
948	25.	1.2	1.9	2.6	3.4	4.1	4.8	5.5	6.3	7.0	25.	948
950	27.5	1.2	1.9	2.5	3.3	4.0	4.7	5.3	6.1	6.8	27.5	950
952	30.	1.1	1.8	2.4	3.1	3.8	4.5	5.1	5.8	6.5	30.	952
954	32.5	1.1	1.7	2.3	3.0	3.6	4.3	4.8	5.5	6.2	32.5	954
956	35.	1.0	1.6	2.2	2.9	3.5	4.1	4.6	5.3	6.0	35.	956
958	37.5	1.0	1.6	2.1	2.8	3.4	3.9	4.4	5.1	5.8	37 5	958
960	40.	.9	1.5	2.0	2.7	3.2	3.8	4.3	4.9	5.5	40	960
962	42.5	.9	1.5	2.0	2.6	3.1	3.6	4.1	4.7	5.3	42.5	962
964	45.	.9	1.4	1.9	2.5	3.0	3.5	4.0	4.6	5.1	45.	664
965	47.5	.8	1.4	1.9	2.4	2.9	3.4	3.9	4.4	4.9	47.5	965
967	50.	.8	1.3	1.8	2.3	2.8	3.3	3.8	4.3	4.8	50.	967
969	52.5	.7	1.2	1.7	2.2	2.6	3.1	3.6	4.1	4.5	52.5	969
970	55.	.7	1.2	1.6	2.0	2.4	2.9	3.4	3.8	4.2	55.	970
972	57.5	.6	1.1	1.5	1.9	2.2	2.7	3:1	3.5	3.9	57.5	972
973	60.	.6	1.0	1.4	1.8	2.1	2.5	2.9	3.3	3.6	60.	973
974	62.5	.6	1.0	1.3	1.7	2.0	2.4	2.7	3.1	3.4	62.5	974
976	65.	.5	.9	1.2	1.5	1.8	2.2	2.5	2.8	3.1	65.	976
977	67.5	.5	.8	1.1	1.4	1.7	2.0	2.3	2.6	2.9	67.5	977
979	70.	.4	.7	1.0	1.3	1,5	1.8	2.1	2.4	2.6	70.	979
980	72.5	.4	.7	.9	1.1	1.3	1.6	1.9	2.1	2.3	72.5	990
982	75.	.3	.6	.8	1'0	1.2	1.4	1.6	1.8	2.0	75.	982
983	77.5	.3	.5	.7	.9	1.0	1.2	1.4	1.6	1.8	77.5	983
984	80.	.2	.4	.6	.8	.9	1.0	1.2	1.4	1.6	80.	984
986	82.5	.2	.3	.5	.7	.8	,9	1.0	1,2	1.4	82.5	986
988	85.	.2	.2	.4	.6	.7	.8	.9	1.0	1.2	85.	998
990	87.5	.1	.2	.3	.5	.6	.7	.8	.9	1.0	87.5	990
992	90.	.1	.1	.2	.4	.3	.6	.7	.8	.9	90.	992
994	92.5	..	.1	.2	.3	.4	.5	.6	.7	.8	92.5	994
996	95.	..	..	.1	.2	,3	4	.5	.6	.7	95.	996
998	97.5	..	..	..	.1	.2	.3	.4	.5	.6	97.5	998

The instrument in its complete state is made and sold by Mr. Joseph Long, Little Tower-street. The Tables, of which the above is only a portion, and the barometric indicater have been constructed by him and Mr. Atlee.

24, Bloomsbury-square, Sept. 20, 1847.

SAFE MODE OF WORKING THE TUBULAR BRIDGES.

Sir,—In reference to the mode of raising the Britannia Tubular Bridge, (proposed in Number 1264, of your valuable Journal), it is purely an engineering question, and one which principally belongs to the engineers employed in its construction, although doubtless the eyes of the scientific world are turned towards that bold and novel experiment.

There are, however, two very important questions connected with this subject. First, as to the expense of construction. Second, the stability of the structure when completed. The former question affects the pockets of the shareholders of the undertaking, and the latter has reference to the safety of the lives of the passengers who may feel disposed to patronize the line when completed.

I beg to propose, through your widely circulated Journal, a plan which will go far to save the pockets of the shareholders, (so much wanted at the present moment), and, to a still greater extent, tend to preserve the necks of the enterprising travellers.

As the plan of the proposed tubular bridge is upon a novel principle, and the calculations as to strength based upon experiments made with models, it cannot be doubted but the greatest caution will be exercised. Engineers and experimenters are well aware of the fallacious results of formulæ deduced from models, and of the important fact, that, however trustworthy a formula may be within certain limits, it may nevertheless lead to fatal results when carried to an extreme.

The most destructive element in all railway works is unquestionably vibration, whether as affecting the permanency of the slopes of cuttings and embankments, or the stability of bridges, viaducts, and tunnels, and it is quite clear that model experiments can furnish no data by which to calculate the destructive effects of the vibration caused by a railway train at a high velocity. Nor does experience prove that engine-drivers can, under all circumstances, and in all states of the weather, be depended upon to adhere strictly to any prescribed rate of speed.

I would therefore propose, as a matter of economy, to make use of only one tube and one set of rails; and to prevent two trains from meeting in the tube, I would suggest that no locomotive should be allowed ever to pass through the tube with a train attached, but that the trains in each direction shall be drawn by stationary power, or perhaps it would be no difficult matter so to arrange rope-machinery, with revolving cylinders, as to bring the driving-wheels of the locomotive over these cylinders, and by the action of the engine (which being placed on a revolving cylinder could not progress) give motion to the rope-machinery and thus save the expense of stationary power.

By this arrangement, also, the stability of the structure and the safety of the passengers would not be endangered. The weight of the locomotive would not have to be borne by the tube, and the motion of the train would necessarily be so slow as not to generate any destructive vibration.

In adopting two tubes they cannot be any mutual help, unless they are attached to each other, and if so attached, the combined effect of the vibration caused by the passing of trains in opposite directions, may prove much more destructive than can be anticipated; and should it be said that it is not intended to allow two trains to pass each other on the bridge, it will then follow as a matter of course that one tube is as good as two for all useful purposes.

I am, Sir, yours, &c.,

A.

SIMPLE METHOD OF COMMUNICATION BETWEEN ENGINE-DRIVERS AND PASSENGERS.

Sir,—I am a constant traveller by rail, and have read with much interest in your Magazine, the different methods proposed for communicating to the engine-driver any mishap occurring to the train behind him. The following suggested itself to me long before anything was written on this subject, and appears still, to me, to be the most simple, most efficacious, and the least expensive of any hitherto propounded.

Let every carriage, whether first, second, or third-class, horse-box, luggage-van, or goods'-truck, be fitted with a cord of gutta percha, (the same as is now used to drive lathes,) having at each end a spring hook, which hook, when once attached, shall form a continuous pull to a

the tender, or the handle of a
m the engine. The line may be
ust under the roof of the carriage,
rings here and there, and was
ilable to any one reaching out of
; or, if that is objectionable,
through a slight tin tube, and it
only be touched by the guards,
se every engine would carry its
line, ready to be hooked on to
carriage).
s method it will be seen that the
ication-line may be unlinked by
man who detaches the carriages;
he same way a carriage may be
into the very centre of a train,
communication-line hooked to
in front, and the one behind
direct pull to the engine as be-
likewise, if part of a train got de-
y the screws parting, the line
en self-act, at the moment be-
king, and sound its own alarm.
rds, on finding anything amiss,
nly have to pull up the little
line that there would necessarily
is method, and immediately com-
e to the engine-man, whose posi-
ers should be, "whenever that
whatever it be) sounds, stop at
I grant, it might be a frivolous
now and then, but in the end
ic would be the gainers.
in conclusion, to say I am con-
sing your Magazine for refer-
patents and other valuable mat-
d when I see others trying to
e for the public good therein, it
me to send you the foregoing
, and which the railway world
iberty to adopt if they see any
the plan.

I am, Sir, yours, &c.,

VIATOR.

RAILWAY BUFFERS.

I am perfectly aware that *buffers*
te or flat surfaces will have *nearly*
tendency to ride that the ordinary
ave; but I did not suggest such
What I have suggested is, that the
f one carriage should abut upon the
plane surface of the frame, or most
t of the next carriage. And I beg
t that such buffers could not by any
y have "just the same tendency to
the buffers in ordinary use.

am, Sir, yours, &c., S. Y.,

An Engineer.

., 1847,

INQUIRIES AND ANSWERS TO INQUIRIES.

Organ Pipes.—Sir,—As I observe questions asked and answered in your valuable Magazine on all sorts of subjects in the least connected with mechanics, I think it possible that some one among your contributors will kindly favour me with information on a matter in which I am at a great loss for it. I have for some time had it in contemplation to build a musical instrument, into which I wish to introduce several stops analogous to those in an organ. My first difficulty is, want of information as to the construction of a scale of widths for metal open diapason-pipes. Suppose a pipe, one foot long and one inch in diameter, gives C, a pipe double the length will give CC; but what should be its relative diameter? In short, in what ratio to the length should the diameter of the bore increase? I am also anxious to know—supposing it is desired to increase or diminish the scale of *lengths*—in what proportion the corresponding scale of *widths* will require to be diminished or increased? For example, one foot of length, with one inch bore, will give C; but it is wished to make C only nine inches long: what increase of diameter will be required to give the same note? In other words, the speaking *length* of C pipe being given, how must a scale be constructed that will at once indicate the *width* necessary to produce the note? Wood pipes appear to give the best tone when not perfectly square, but oblong. I should be glad to know the best proportions for them. I am perfectly acquainted with the structure of open and stopped diapason pipes, both wood and metal, when completed; but, as to the *modus operandi*, I am greatly at a loss. I can manage to solder a zinc tube together, after a fashion; but my metal pipes are sad, clumsy affairs, and I am perfectly puzzled to conceive how the beautiful neat seams on a few old pewter pipes, out of a small hand-organ which I bought, have been accomplished. Any hints on the practical construction of metal pipes and reed stops, scale of dimensions, &c., of reeds or tongues for seraphine, and methods of tuning them, I should be most grateful for; and if, Sir, you will have the goodness to insert this letter in your useful Magazine, I have great hopes that some one will kindly assist your obedient servant, A MECHANIC.—Bantry, October 30, 1847.

Roman Cement.—"Wherefore *Roman?*" *A Builder.* It was so called, we believe, from a mere whim of the first patentee, Parker. It is one of our own native water cements, and a better cement than Rome ever possessed. Even in this country it is but half a century old. Parker's patent was dated 28th June, 1796.

Weaving.—I shall feel much obliged if you will inform me which is the best work on weaving, or on silk and cotton manufactures generally; and also if I can get small reels or bobbins in London, and where? I remain, &c., "SHUTTLE." White's "Practical Treatise," Glasgow, 1846, is by far the best yet published. We purpose giving an account of it in an early number. There are not many good bobbin-makers in London, but our correspondent will probably obtain what he wants at Hancock's, Thomas-street, Brick-lane.

Cooling.—Water may be cooled many degrees below the freezing point (32°) without being frozen or converted into ice; and this explains the apparent "anomaly" which has excited the surprise of "Aquarius." Deluc cooled it down to 14° below 32°; Blagden, to 12°; Walker, to 22°. When reduced to these very low temperatures, however, the instant it does freeze, it starts back to 32°, as if it actually required to be somewhat *warmed* before it could become *ice.*

Gold Watch-cases, when of standard quality, should contain 18 carats of fine gold and not more than 6 of alloy. No gold of inferior quality ever receives the Hall mark.

Electrotype Plating.—Messrs. Elkington and Co. have, we believe, quite abandoned the processes which go by their name, and now do all their work by the electro-magnetic process of the late Mr. J. S. Woolrick. "P. B." will find the latter fully described in our Journal for 25th Feb., 1843, No. 1020.

Mathematical Exercises.—It is our intention to resume the solutions at no distant period. We shall also give the analysis of the problems of "Lineal Section," the constructions of which were published nearly half a century ago in the *Liverpool Student:* but we fear that they must be delayed a little longer. The idea of such a mathematical periodical as our friend Mr. Wilkinson suggests, is one which has often been mentioned to us; but we are convinced that it could only be conducted at considerable pecuniary sacrifice. Not one of the *purely* scientific periodicals of the age could be maintained were they conducted with reference to emolument.

MATHEMATICUS wishes to be supplied with the dates of the English periodicals which have been more or less devoted to mathematics. Perhaps some of our friends may be able to give them; and if any particulars respecting management, editorship, &c., could be added, it would be, as our correspondent remarks, "of great use."

WEEKLY LIST OF NEW ENGLISH PATENTS.

George Henry Bursill, of Hornsey-road, Middlesex, and Joseph Radford, of Maida-hill, for improvements in envelopes, wrappers, and covers, and in machinery and apparatus for the manufacture thereof. November 6; six months.

John Robertson, of Tweedmouth, Berwick, gentleman, for improvements of architecture, the elementary method of formation employed in the same; also further applicable for harmonizing formation, as of urns or vases. Nov. 9; six months.

Henry Fielder, of Carlton-villas, Maida-vale, Middlesex, for improvements in the construction of iron beams or girders. November 9; six months.

Edward Wand, of Bradford, Yorkshire, spinner, for certain improvements in the construction of machinery for preparing and spinning alpaca, mohair, wool, flax, and other fibrous materials. November 9; six months.

George Heaton, of Birmingham, engineer, for improvements in locomotive engines. November 9; six months.

Henry Krebs Claypole, of Liverpool, gentleman, for certain improvements in the process, apparatus, and machinery for making sugar. (Being a communication.) November 9; six months.

Joseph Jean Baranowski, of 3, Rue Neuve Clichy, Paris, gentleman, for a ready-reckoning machine. November 11; six months.

Israel Kinsman, late of New York, but now of Ludgate-hill, London, for improvements in the construction of rotary engines, to be worked by steam, air, or other elastic fluids. Nov. 11; six months.

Frederick Collier Bakewell, of Hampstead, Middlesex, gentleman, for certain improvements in machinery, or apparatus, for making or manufacturing soda-water, and other aerated waters. November 11; six months.

Samuel Salmen, of Houndsditch, Middlesex, manufacturer, for improvements in rendering certain materials applicable as a substitute for leather, paper, papier maché, and oil-cloth, in various articles of manufacture. (Being a communication.) November 11; six months.

George James Soward, of Huntley-street, Bedford-square, gentleman, for improvements in suspending windows, sashes, shutters, and blinds, and in the construction of the frames for the same. (Being a communication.) November 11; six months.

Charles Blachford Mansfield, of Clare-hall, in the University of Cambridge, Esq., for an improvement in the manufacture and purification of spirituous substances, and also applicable to the purposes of artificial light and various useful arts, and in the application thereof to such purposes, and in the construction of lamps and burners applicable to the combustion of such substances. November 11; six months.

WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

Date of Registration.	No. in the Register.	Proprietors' Names.	Addresses.	Subjects of Designs.
Nov. 3	1253	Thomas Attwood	Lewes, Sussex	Singing apparatus.
9	1254	Joseph Collins	Birmingham	Indian-rubber holder.
"	1255	Brown, Marshall, and Co.	Birmingham	Ventilator for railway and other carriages.
"	1256	Richard Sharp	Westmoreland-street, Dublin	Horological tell-tale.

year; and from my occupation as a general post letter-carrier, you may be sure that they have had more than a common fair trial, and the Gutta Percha seems now as firm and as little worn as on the first day. W. HUTTON, G. P. O. Letter Carrier.

To E. Granville, Esq., Gutta Percha Works.

28, St. John-street, August 25th, 1847.

Gentlemen,—It gives me great pleasure to acquaint you that the Gutta Percha Soles I had from your Works have answered the purpose admirably, as I can fully testify, having had them in wear six months, during the winter, in Smithfield-market, and have not been subjected to the annoyance of wet feet, as is often the case with leather soles, and, in my opinion, they wear three times as long.

H. I. TARLING.

To the Gutta Percha Company.

N.B.—The above Soles, which are not worn out, may be seen at the Gutta Percha Company's works.

No. 3, Union place, New-road,

Dear Sir,

I have worn the Gutta Percha Soles for nearly a year, with much satisfaction and comfort: in wet and cold weather they keep the feet perfectly dry and warm—are pleasant to wear, and I have found them more durable than leather.

I am, Dear Sir, yours faithfully,
W. GORTON.

To the Secretary of the Gutta Percha Company.

Advantages of Registering Designs for Articles of Utility.

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ENGINEERS, and all Manufacturers in Brass, &c., &c., are respectfully invited to test the quality of these new alloys, which have already received the sanction of eminent engineers and parties connected with public works. One sort for bearings and engineering purposes generally, will be found superior in quality, and cheaper than the metals now in use. Other sorts will be found of a better colour, a more brilliant surface, and bearing a higher polish than any ordinary brass. Messrs. Mears will be happy to send any quantity as samples, or to make any castings from patterns sent to them.

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MESSRS. MEARS beg to call the attention of the Trade and the Public generally to these articles, which they are now prepared to supply in any quantity and variety. The composition is of a new metal, called the Union Metal, and the bells are of very beautiful tone, and cheaper than those made of the ordinary bell metal. Orders received at the Bell Foundry, Whitechapel, for house, cattle, and other bells.

The Claussen Loom.

APPLICATIONS for Licenses to be made to Messrs. T. Burnell and Co., 1, Great Winchester-street, London.

Just Published,

Price Sixpence,

A Familiar Description of a Wooden Bridge, and the Tube and Valve for an Atmospheric Railway; with full directions to the workmen, showing how these articles are to be manufactured. By Henry Charles Lacy, Esq., M.P. October, 1847. London: Whittaker and Co. Bodmin: Liddell and Son.

NOTICES TO CORRESPONDENTS.

Mr. Adcock's reply to Cassell Morlais and other correspondents is unavoidably deferred till our next; as is also the further notice promised of Mr. Simpson's Submerged Horizontal Propeller.

Communications received from *B. B.—Sector—T. S. N.—Vectis—An Occasional Reader—Querist—A.*

CONTENTS OF THIS NUMBER.

LONDON: Edited, Printed, and Published, by Joseph Clinton Robertson, of No. 165, Fleet-street, in the City of London.—Sold by A. and W. Galignani, Rue Vivienne, Paris; Machin and Co., Dublin; W. C. Campbell and Co., Hamburgh.

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MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 1267.] SATURDAY, NOVEMBER 20. [Price 3*d.*, Stamped, 4*d.*

Edited by J. C. Robertson, 166 Fleet-street.

BRYANT AND TOTHILL'S TRANSPOSING PLOUGH.

Fig. 1ᵃ.

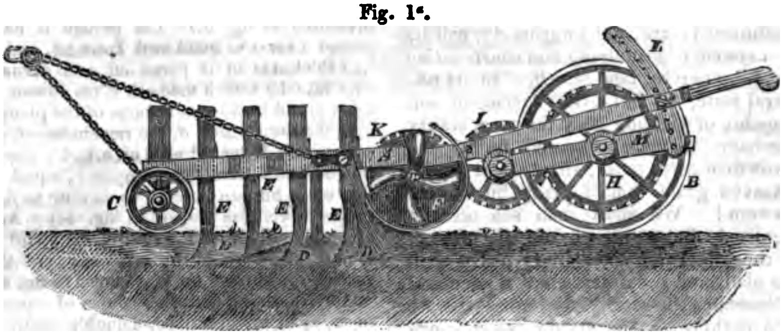


Fig. 2ᵃ.

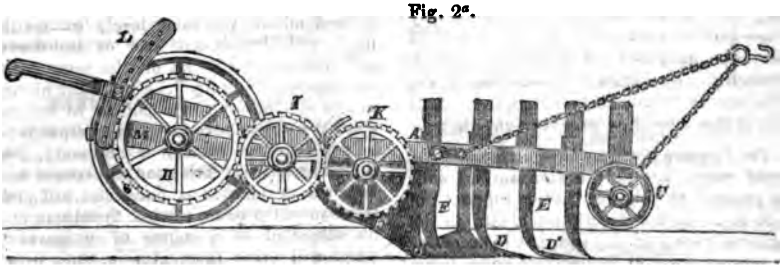
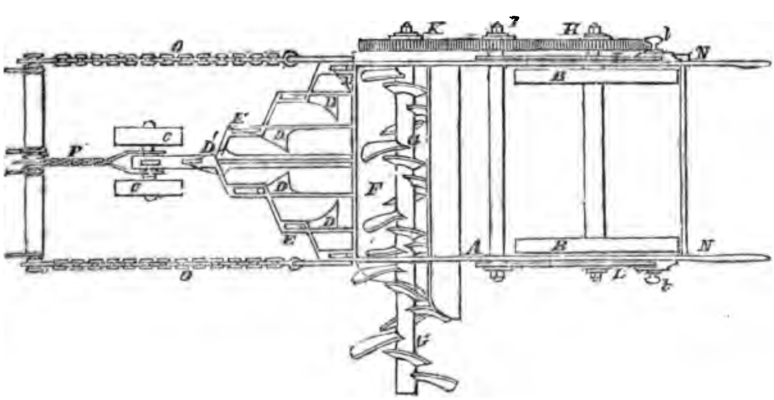


Fig. 3ᵃ.



BRYANT AND TOTHILL'S LAND TRANSPOSING SYSTEM.

[Patent dated 8th May, 1847; Specification enrolled 8th November, 1847.]

The objects proposed by the present patentees are of more than ordinary importance, and carried out with a great deal of skill and ingenuity. They propose nothing less than the introduction of a new mode of tillage, or, as they technically, and not improperly, call it, "a system of *preparing* and *constructing* land," whereby land which, "in its natural state, has but a thin surface of soil capable of yielding only the most scanty herbage, may be rendered fit for the growth of corn, pulse, shrubs, and trees." Heaven grant that it prove but a true system! We shall then see literally realized the words of the Scriptures; "the wilderness and solitary places shall be glad, and the desert shall rejoice and blossom as the rose." For ourselves, we see nothing in the system, as it is expounded by the inventors, but what is of an exceedingly rational and perfectly practical character. The problem which they have undertaken to solve is simply this—how to make soil that is too thin for the purposes of vegetation, thick enough? The answer is—double it, or, if necessary, treble and quadruple it. And this is the way they go about the task:

To Prepare for Arable purposes Poor Land which has only a thin surface soil, we proceed as follows: Let us suppose the land to be of the description shown in the sectional view, (fig. 1,) and that the section, A, represents a surface-soil of some three or four inches only in depth, with a substratum, B, of chalk and gravel. We take a plough of the construction afterwards described, which from its peculiar construction we call a "transposing plough," and adjust the shares and cutters (by means of the slotted segments provided for the purpose,) so that they shall penetrate the ground just between the soft surface soil, A, and the hard subsoil, B. We then run the plough down the space indicated by the arrow, *b*; (fig. 2,) leaving a space, *a*, equal to the breadth of the plough on the outside, whereby all the surface-soil of the section, *b*, is pared off, and as it is pared off is gathered into the apron of the machine, and thrown by the lateral action of the rotating shaft (G) over upon the top of the surface-soil of the space, *a*, which is thus doubled in depth. By the return course of the plough up the space, *c* the surface-soil of that space is in lik e manner thrown over upon the top of the surface-soil of the right-hand space, *d*, which doubles that also in depth, but temporarily only. We then cut a trench in the stripped portion of land, *c*, and throw the excavated subsoil over upon the top of the other stripped portion, *b*, which raises that to its original level, (as represented in fig. 3.) The plough is next passed over the good soil space, *d*, and a half thickness of it pared off and thrown over into the trench made in *c*, (as shown in fig. 4;) and by a second course of the plough over the same space, *d*, the remainder of its surface-soil is turned over on *c*, and a depth of good soil thus formed upon *c*, equal to that on *a*, but on a level some four or five inches lower, (as shown in fig. 5.) Another breadth of land, *e f*, equal to *b* and *c*, is next laid bare in the same way, and the surface-soil thrown on *f* (as shown in fig. 6), and by repeating the same course of operations, as before described, a double depth of surface-soil is formed on *f*, and the space, *e*, filled up to its original level with the refuse stuff. And so the operation goes on, till a series of trenches filled with good soil are formed all on the same level, (except the first) with breadths of bad or indifferent soil between them, all on the same level, (as represented in fig. 7.) Should the plough not be able in any single course to accomplish the work above assigned to it, it must be run twice, or oftener if necessary, over the same space. The good soil spaces may be sown or planted at once, and will yield an abundant produce; while the others may be subjected to a course of preparation which will bring them also in time into a productive state.

The transposing plough referred to is a very cleverly contrived instrument, and, independently of its peculiar adaptation to this land transposing system, will be found of great general utility. The construction of it is represented in figs. 1ᵃ, 2ᵃ, and 3ᵃ.

Fig. 1ᵃ and 2ᵃ are two side elevations of it in reverse positions, and fig. 3ᵃ, a plan. A, A, is the frame-work; B, B, the bearing-wheels; C, C, guide-wheels; D, D, flat-bottomed ploughshares, of which the central one is of a triangular form, and all the others are semi triangular, with the blade on the inner side; E, E, are cutters, one of which is fixed immediately in front of each plough-share; F, is a curved apron (before mentioned) into which the soil, as it is turned up by the shares and cutters is gathered; which apron is closed at one end, but open at the other; G, is a shaft (also before men-

Fig. 1.

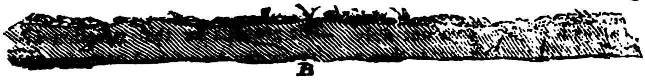


Fig. 2.

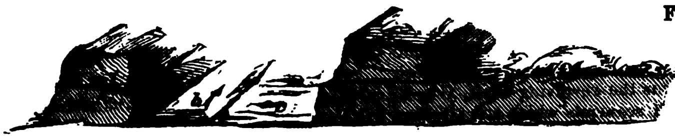


Fig. 3.

Fig. 4.

Fig. 5.

Fig. 6.

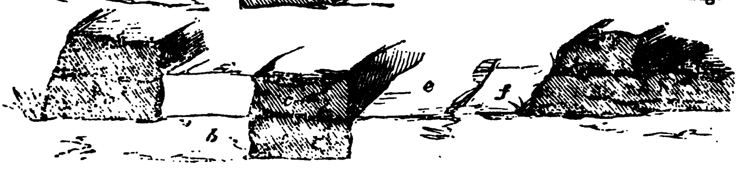
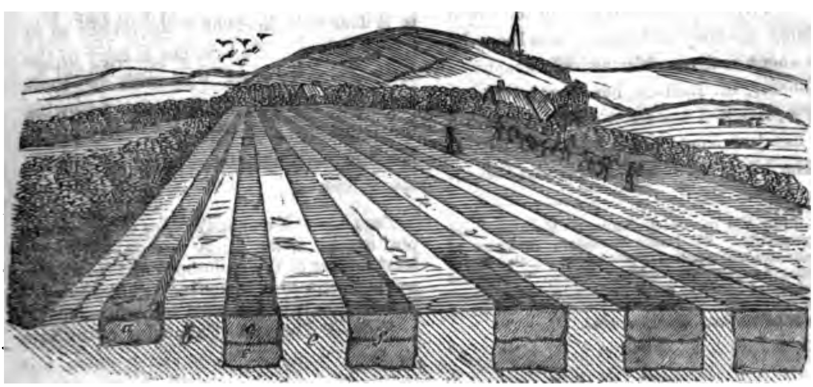


Fig. 7.



tioned,) which rotates within the apron, and is armed with a number of sharp blades, all curved in an outward direction—that is, in a direction inclined towards the open end of the apron; which blades serve not only to break up the soil still further, but to throw it out sidewards on to the adjoining land; H, is a toothed wheel affixed to the right-hand end of the shaft of the main-bearing wheels, B, B, which, through the medium of a screw-wheel, I, works a third wheel, K, which turns the revolving-shaft, G; L, L, are slotted segments which are attached to the under framing, M, and pass upwards through the handle-ends, N, N, of the top framing, and *l*, *l*, pins, by passing which through the handle-ends and segments, the top framing (which carries the shares, cutters, apron, and rotating shaft,) can be fixed at any length required; O, O, are the horse traces; and P, a chain by which the guide-wheels are connected to the swing-bar of O, O.

The present plan will probably recal to the recollection of some of our country readers one of a somewhat analogous character proposed by a Mr. Thos. Vaux some eight or ten years ago. The difference between them is, however, very decided. What Mr. Vaux had in view was to introduce the growth of turnips on poor lands, and to enable the crops to be fed off where grown; which purpose he proposed to effect by tilling and sowing the land in small squares, leaving spaces around them in their primitive state, for sheep to tread and lie on. He did not transpose at all. Messrs. Bryant and Tothill, on the contrary, break up the whole of the soil, and depend entirely on transposition for their results.

WEISBACH'S MECHANICS.*

Julius Weisbach is "Professor of Mechanics and Applied Mathematics" in the Royal Mining Academy of Frieberg, who has written a book on these subjects which our spirited publisher, M. Baillière, has thought deserving a place in a new serial publication which he has just commenced, under the title of "The Library of Illustrated Standard Scientific Works," and has had therefore translated for the purpose, under the superintendence of Professor Gordon, of Glasgow. The grounds for this selection are (according to the translator) "the well-earned reputation of Professor Weisbach as a teacher and original investigator"—the "able manner in which he has treated both the theoretical and practical portions of his subject," "and the variety and abundance of examples which illustrate the principles and formulæ." As for the reputation of Professor Weisbach, whether "well-earned" or not, we can only say, that it has not before reached us, and is, we suspect, somewhat of a local character. Of his "manner," his "principles and formulæ," his "examples," &c., we now propose to speak.

But before judging of the Professor by the work before us, we must in fairness to him say a word or two, on the manner in which it has been rendered into English. Anything less commendable in this way we have seldom met with. The translator is manifestly some person who, though he may know German, knows little of the matters treated of; and who, as a matter of course, fails, in almost every other page, to catch the meaning and spirit of the original, and not unfrequently makes the author talk great nonsense—such nonsense as we should never think of imputing to any one in Professor Weisbach's educational position. "The translation" is said, by the translator to be "much indebted to the revisal of the proofs by Professor Gordon." What then must it have been *before* such revisal! It is a pitiful thing to think of. As it is, it does as little credit to the reviser as to the translator. We have not a copy of the original German work wherewith to compare this translation; but the following specimens will suffice to show that we do not find fault with the translation without ample reason:

Page 1.—"Everybody *takes up* a certain position in space." A person with the least inkling of the philosophy of the subject would have said "*occupies*." "Takes up" in the sense it is here used is a vulgarism.

Ibid.—"The path of a moving point is a

* Principles of the Mechanics of Machinery and Engineering. By Julius Weisbach, Professor of Mechanics and Applied Mathematics in the Royal Mining Academy of Frieberg, Vol. I, Theoretical Mechanics, 542 pp., Royal 8vo., with 534 Engravings on wood. Library of Illustrated Standard Scientific Works. Baillière, 1847.

hat of a geometrical body is *another* Not so, surely, in the original.

.—"The greater the space is which *describes* in a given time, the *stronger* notion and the greater its velocity." *ibes'* for *passes through*; '*the stronger notion*' for *the greater is the moving*

.—"The *strength* or magnitude of nge in the velocity of a body is called ation;" *strength*, for *amount* or *quan-*

0.—"The *height of velocity* at the it of impact is, &c." Height of y!

3.—"NO : CE = DO : DE." For $\frac{DE}{D.O}$.

1.—"Two uniformly accelerated mo- *eginning with null velocity*, produce, *combined*, a uniformly accelerated in a straight line." "Beginning ull velocity" may possibly be the 's own, for German professors are as f refining as of mystifying; but Weis- imself would doubtless say, if he knew h, *combine to produce*.

2.—"While *constant* forces always the same way, and therefore produce fects in *like particles of time*, *i. e.*, ncrements or decrements of velocity, ects of variable forces are different *rent times*; while the former bring a uniformly variable motion, to the corresponds a variably accelerated or bly retarded one." "Constant" for *s*; "like particles of time" for *times*; "at different times," non- "uniformly variable motion," for *bly uniform motion*.

.—"Pressure and *traction* are the fects of forces upon material bodies." tion" for *motion*.

9, 80.—"Diameter" and "Radius" ndiscriminately to express the same

01.—"If a point of a rigid body is any other point *may take up a motion* path lies in the surface of a sphere, ed from the fixed point, as a centre, distance of the other point as ra- "Take up a motion!" The mean- obably is, "If we suppose one point gid body to be fixed, and another to in motion, with the fixed point for re and the distance between the two as radius, the moving point will de- a path which lies in the surface of a ."

144.—"The gudgeon rubs against its t or envelop; *whilst its other points* successively come into contact with me points of the support." "Other points?" What are they? And other than what?

P. 180.—"Many bodies are hard, others soft: *the* one opposes a great resistance to a separation of *their* parts, whilst the others easily allow of this to be *brought about*." Mere carelessness this; but such careless- ness as is of constant recurrence.

P. 204.—"Bodies of equal section very often possess different relative strengths; the formula

$$Pl = \frac{K}{6} \cdot bh^2$$

shows that the strength increases in the breadth as the square of the depth, and inversely as the length of the beam. The depth has consequently a greater influence upon the tenacity than the breadth; *a beam of double the breadth bears twice as much: i. e., as much as two single beams: on the other hand a beam of double the depth, four times that of a beam of the same depth*."

The "*i. e.*" (an explanation interpolated apparently by the translator) is an absurdity; for the two single beams may, though sin- gle, be each of any breadth. Again; there is a "double depth" and a "same depth," without any normal depth to which they have reference. All this confusion of terms might have been avoided by simply saying, "A beam of double the breadth of another, will bear twice as much, and one of double the depth of another, four times as much."

Ibid.—(Strength of Beams).—"This rule must be particularly attended to, viz., always to lay the beam *less on the side*, or rather to lay it so that the pressure may act in the direction of the *greater side*." "Less on the side?" What does this mean?

More exemplification is not needed to show that the Professor has been indeed singularly unfortunate in a translator. Keeping always in mind therefore that large allowances are to be made for him on this score, and regarding him as answerable only for such things as belong indisputably to the substance of the work, let us see how that sustains the high and "well-earned" reputa- tion claimed for him.

The "Laws of Motion" first occupy his attention. The mention of this subject re- calls irresistibly to the mind of the English reader the prominent place which it occupies in the "Principia" of our own illustrious New- ton, and the admirable development which the methods of investigation there employed, have received in recent times at the hands of

Professor Whewell (Dynamics, Parts I. and II.);—recollections which prompt no less irresistiblythe incredulous question—Whatcan this Frieberg Professor have to tell us about such things, after they have been handled by these masters in philosophy? We regret to say, that the only answer we can make is a most unfavourable one. Not only has Professor Weisbach nothing new to tell us, but in re-telling what was known before, he does it with all the awkwardness of a novice. What Newton and Whewell had reduced to the most beautiful simplicity, precision, and clearness, he has by a most perverse process of hashery, rendered altogether vague, obscure, and unsatisfactory. He illustrates by "examples," it is true, more than either of the great authorities we have spoken of, and in that way it was open to him to have rendered good service to the cause of practical science; but *his* examples are such as in general to exemplify only, that extreme proneness to error which is the constant accompaniment of confusion of ideas. We do not, of course, make such serious charges without being ready with our proofs; and here they are.

Of the velocity of projected bodies we have the following example (p. 10:)

"A body is thrown up with a 15 feet velocity, and strikes in its rise against an elastic impediment, which for a moment throws it back with the same velocity with which it struck. How great, then, is this velocity and the time of ascending and descending? To the velocity ($c=15$ft.) corresponds the height of ascent $h=3{,}49$ ft. the height of the velocity at the moment of impact is $h_1=549-2{,}00=1{,}49$, and consequently this velocity $=8{,}03\sqrt{1{,}6}=9{,}636$ ft: the time to attain the whole height (3,49 ft.) is $t=0{,}032.v=0{,}032{,}15=0{,}480''$, for the height 1,49 ft. $t_1=0{,}032.10=.0{,}320''$; there remains then for the time required to rise to the height of 2 feet, or the time from the commencement to impact

$$t-t_1=0{,}480-0{,}320=0{,}160''$$

and the whole time of rising and falling $=2.160=0{,}320$ ft."

The question to be solved was (in substance) how many seconds of *time* a body propelled upwards at 15 feet velocity would take in rising and falling? The answer is "0,320 *feet*"!!! We are willing to believe that the change of *c* into *v* in the course of this solution, the frequent use of the comma for the decimal point, and the ultimate conversion of 320 seconds of time into so many feet, may be all clerical errors ascribable to the ignorance and carelessness of the translator; but who else, save the Professor himself, can be to blame for the process of calculation itself being essentially erroneous? That it is so, the reader will be fully satisfied by comparing it with the following, which is the correct solution. The velocity c being $=15$ ft., and the height of ascent $h=3.49$ ft., then $h_1=3.49-2=1.49$, and consequently, the velocity $=8.03\sqrt{1.49}=9.797$. $t=.0.31.c=.0.31\times 15=.465$; for the height $t_1=0.31\times 9.797=.3037''$; and $t-t_1=.465''-3037=.1613''$; whence the whole time of rising and falling $=.1613\times 2=.3226''$.

Further on (p. 15) we have "compound motion" thus defined.

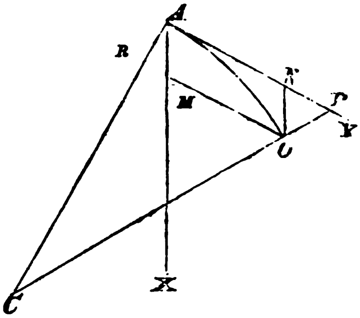
"One and the same body may at the same time have two or more motions; every (relative) motion consists of the motion within a certain space, and of the motion of this space within or in relation to a second space."

The motion of a body may be the resultant of an indefinite number of motions, but it is impossible for more than one motion to exist at the same time in the same body. If a body consist of a system of bodies, the bodies composing the system may be in motion, independent of the mass; but it is impossible that the bodies individually or collectively can have more than one motion at the same time. Two converging forces acting on a mass cause it to describe the diagonal of the parallelogram of which the forces form the adjacent sides; but the motion of the mass along the diagonal is uniform, and though the resultant of two motive forces, is but one motion.

Of the "Radius of Curvature" of a projectile, we have the following demonstration (p. 27:)

"Let A M be a small trajectory described with an uniform accelerated motion $x=\frac{pr^2}{2}$ in the direction A X; and let A N be a very small uniformly described trajectory $y=c\,r$ and O the fourth terminating

point of the parallelogram constructed from x and y, *i. e.*, the point which a body proceeding from A would occupy at the end of the short time (τ). Let AC, be drawn at right angles to AY, and let us observe from what point C in this line a small arc of a circle through A and O can be drawn.



On account of the smallness of the arc, AO, we may assume that not only CA, but also COP is at right angles to AY; that therefore in the small triangle, NOP, the angle, NPO, is a right angle. The solution of this triangle gives us OP = ON sin. ONP = AM sin. XAY $= \frac{p\tau^2}{2}$ sin. a and the tangent AP $=$ AN + NP $= c\tau + \frac{p\tau^2}{2}\cos. a = (c + \frac{p\tau}{2}\cos. a)\,\tau$ may be made $= c\tau$, because $\frac{p\tau}{2}\cos. a$ on account of the infinitely small factor τ, is inappreciable with respect to c. But now, according to the property of the circle $\overline{AP}^2 = PO \times (PO + 2CO,)$ or as PO vanishes when compared with 2CO, $\overline{AP}^2 = PO \times 2CO$; we have therefore the desired radius of curvature

$$CA = CO = r = \frac{AP^2}{2PO} = \frac{c^2\tau^2}{p\tau^2 \sin. a} = \frac{c^2}{p \sin. a}."$$

Now if we admit the reasoning here employed by the professor, we must first allow that it is possible to draw two lines from the centre of a circle, at right angles to the same tangent: secondly, we must neglect the quantity $\frac{p\tau}{2}$ cos. a, and make the tangent less than its corresponding arc; and, thirdly, we must neglect the quantity, PO, in one part of the equation, "because it vanishes as compared with CO," and yet retain it as a denominator of the fraction in the same equation. All these defects are so obvious as to need no comment, and they are the more blameable that the investigation is exceedingly simple. For, since $c\tau =$ AN, and $\frac{p\tau^2}{2} =$ AM,

$$AO = \sqrt{(c\tau)^2 + \left(\frac{p\tau^2}{2}\right)^2 + cp\tau^3 \cos. a}\,;$$

extend OM to R; then because OR is parallel to AY, MRA $= 90^\circ$ and AR $= \frac{p\tau^2}{2}$ sin a; but by the property of the circle

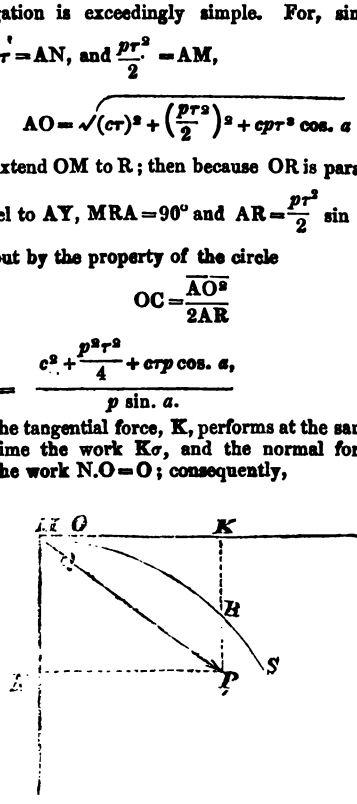
$$OC = \frac{\overline{AO}^2}{2AR}$$

$$= \frac{\tau^2\left\{c^2 + \frac{p^2\tau^2}{4} + c\tau p \cos. a\right\}}{p\tau^2 \sin. a.} = \frac{c^2 + \frac{p^2\tau^2}{4} + c\tau p \cos. a,}{p \sin. a.}$$

which is the equation to the radius of curvature and *not* CO $= \frac{c^2}{p \sin a}$, as the professor gives it.

Curvilinear motion, is thus explained (p. 60.)

"Let MORS be the path of a material point, and $MP_1 = P_1$ the resultant of all the forces acting upon it; if we resolve this force into two others, of which one, MK = K, is tangential, and the other, MN = N, normal to the curve, we here term the one a tangential and the other a normal force. Whilst the material point describes the element MO $= \sigma$ of its curved path, MS, and its velocity, c, is transformed into v_1, its mass, M lays claim to the work $\left(\frac{v_1^2 - c^2}{2}\right)$ M; but the tangential force, K, performs at the same time the work Kσ, and the normal force the work N.O = O; consequently,



$$K\sigma = \left(\frac{v_1^2 - c^2}{2}\right)M.$$

"If the projection, MQ, of the elementary space, MO, in the direction of the force be put $=\sigma_1$ then also $P_1\sigma_1 = K\sigma$, and therefore

$$P_1\sigma_1 = \left(\frac{v_1^2 - c^2}{2}\right)M."$$

Nothing could well be more absurd than all this. If the mass, M, is deflected from the right line MK, by a force, N, acting in the direction of the normal, MN; then the force, N, must do some work, or the mass would not be deflected at all from its tangential path; and hence $N_1O = O$ would not measure it, nor would $K\sigma$ be $= \frac{v_1^2 - c^2}{2}M$. Further, $P_1\sigma_1$ is *not* equal to $K\sigma$, for if it mean anything, it must be the resultant of the work done by N and K, and therefore,

$$P_1 = \sqrt{K^2 + N^2 + 2\,NK \cos. NMK};$$

but $NMK = 90°$, therefore, $\cos. NMK = 0$, and $P_1 = \sqrt{K^2 + N^2}$; also $\sigma_1 = \sqrt{\sigma^2 + \sigma_2^2}$, where σ_2 is an element in the direction, MN; hence,

$$P_1\sigma_1 = \sqrt{K^2 + N^2}\ \sqrt{\sigma^2 + \sigma_2^2} = K\sigma + N\sigma^2 \qquad \text{and then}$$

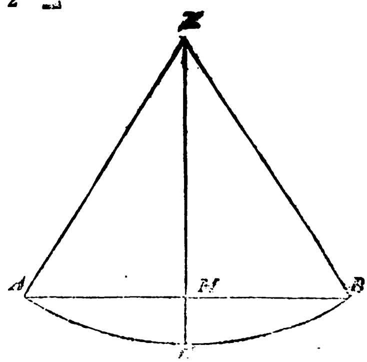
$$P_1\sigma_1 = K\sigma + N\sigma_2 = \frac{v_1^2 - c^2}{2}M.$$

The Professor gives, immediately after, another example of curvilinear motion (p. 61), in which gravity is the force applied; and as this acts in the direction of the normals, the work done is measured by $(h - h_1)M$. So that here we have h and h_1 employed as an element of the normal, and the work done actually measured by the normal, which but a few lines before the Professor had assumed to be $= 0$!

So much for the light thrown by the Professor on the Laws of Motion. He does not himself seem to think that there is any thing in this portion of his book to be particularly proud of, for though he very kindly, and with rare modesty, points out to his readers and critics that there is "in almost every chapter," "much that is new and peculiar to the author." he passes over the contents of the first hundred pages as containing nothing but "smaller matters" not worthy of special mention (Author's Preface, p. xiv.)

Among the things in the remainder of the volume to which he specially challenges attention, is "an approximate formula for the catenary," given at pp. 130, 136. Here it is:

"Let s be the length, $x = CM$ the absciss, and $y = AM$ the ordinate of a very compressed arc, AC. If we make $AK = CK$ we may consider this arc as a circular one described from K as a centre. Since from the known equation of the circle $y^2 = x(2r - x)$, it follows that the radius, CK, of the circle $r = \frac{y^2}{2x} + \frac{x}{2}$, or more simply if we neglect



$\frac{x}{2}$ as small in comparison with $\frac{y^2}{2x}$, $r = \frac{y^2}{2x}$," &c., &c.

Altogether erroneous. The equation to the *catenary* is $y = a\,hy.\log.\frac{x + a + \sqrt{x^2 + 2ax}}{a}$, and not $y^2 = x(2r - x)$, which is the equation of *the circle*.

The Professor afterwards drops $\frac{x}{2}$ as being "small in comparison with $\frac{y^2}{2x}$" (it is *only* half the deflection, CM) and gets $r = \frac{y^2}{2x}$, which is precisely the equation which he had previously, by a similar process of ratiocination, obtained for the radius of curvature of a projectile (see *ante.*)

And so he goes on blundering through half a dozen pages, applying to the matter in hand equations which have no connection whatever with it, and landing himself at

conclusions utterly false and unten-

her portion of his labours which the
ɔr points out as "new and peculiar,"
ɪinently deserving of attention, con-
certain "supplements to the Theory
Friction of Axes." For examples of
ake the following:

the axle lies in a prismatic bearing
greater pressure, and consequently,
riction than in a round bearing,"
·)

ɔm this, the friction (in round bear-
ɪere the axle touches at all points),
;er the deeper the axle lies in its
s," (p. 160.)

ɪrst of these supplements (corollaries)
;nough, and obvious enough; but the
is a piece of mere assumption, for
o sufficient reason is given. Both
l and Moseley measure the amount
.on of axles by the size of the angle
ɪg *quite irrespective of the depth of*
in its bearings, (Whewell's "Me-
of Engineering," p. 92;— Moseley's
ɪeering and Architecture," p. 170.)
R = the resultant of pressure on the
= the angle of sliding, and r denote
ius of the axle—then Rr sin. q = the
ce from friction. And this is so
l sound a mode of calculation, that
ɪdon it for Professor Weisbach's
and peculiar" mode would be fool-

:d, there is not a single portion of this
hich, if compared with any corre-
g portion of Whewell or Moseley,
t suffer prodigiously by the compari-
Jowhere do we meet with the same
; of notation, or clearness of reason-
7e would particularly instance the
on the "Fundamental Ideas and
ɪental Laws of Mechanics," as com-
ith Whewell's "Elementary Princi-
Mechanics," (anything better than
n the subject never was penned;)
the chapter on "Elasticity and
'," as compared with Moseley's
ɑt of these subjects. (*Eng. and*
·. 535, *et seq.*)
e Professor Weisbach might have been expected to differ from the writers who have preceded him, because of the corrections which subsequent experiment and practice have shown to be necessary in their theoretical deductions, we find him following slavishly in the beaten path. When he differs from others, it is chiefly in order to darken with words, and perplex with figures and symbols (*more Germanica.*) For example; in treating of the flexure of bodies (called *flexion*, by the translator) he adopts the error (so at least we regard it) common to most writers on the subject (Moseley not excepted) of considering the neutral axis as coincident with the centre of gravity. Thus we are told that

$$M = \frac{WE}{\rho} \text{ or } \frac{1}{\rho} = \frac{M}{WE}$$

is synonymous with

$$\frac{1}{R} = \frac{\Sigma Px}{EI}$$

(Moseley's *Eng. and Arch.*, p. 501, equation 506); where $R = \rho$ = radius of curvature, $M = Pr$ = the moment of pressure, E = the modulus of elasticity, and W = I = the moment of inertia. And the integration of the last quantity (W), Weisbach, like others, obtains by proceeding on the supposition that the neutral axis round which the section would revolve, passes through the centre of gravity.

Now the experiments of Professor Barlow, contained in his "Essay on the Strength of Materials and on Construction," show clearly, that the neutral line of a beam (except in some very peculiar cases) does *not* coincide with the centre of gravity; and in this conclusion Mr. Barlow is fully borne out by the later experiments of Mr. Eaton Hodgkinson. In the above equation

$$W = b\int_{-\frac{1}{2}d}^{\frac{1}{2}d} x^2 = \tfrac{1}{12}bd^3 -$$

whence by substitution

$$M = \frac{E}{\rho}.\tfrac{1}{12}bd^3 = ..(1)$$

But following Barlow (68 and 323,) we obtain for the equation

$$M = \frac{E}{\rho}.\tfrac{1}{3}bdd_1{}^2......(2)$$

It is easily seen that if d_1 equation (=2) $\frac{1}{2}d$, then equations (1) and (2) would be alike; but as there is no reason that this should be the case, it would seem to follow, that if the moment of inertia, W, is retained with equation (1,) it should be integrated between the limits of $x=\frac{1}{2}d$ and $x=-(d+d_1)$; noting always that the respective values of the tensile and compressive forces which act on the + and − side of the neutral axis, should be retained during the operation.

We regret exceedingly to have been obliged to speak in terms so unfavourable of this work. The spirit and enterprize of the publisher, the handsome and costly style in which the book is produced, and the great probable usefulness of the series of works of which it forms a part, are considerations which make the duty of censure in this case more than usually painful. To have dealt more gently with it would, however, have accorded as little with the interests of truth as with those of the publisher. Such a work is only to be served by great praise. Either it is a Course of Mechanics and Engineering, better than anything of the sort we have of native production, and which ought, therefore, to supersede all others in our colleges, academies, and schools, or it is a work which ought never to have been translated at all into our mother tongue. We cannot possibly, in the face of the blunders, errors, and defects which we have shown to pervade it, say that it is a work of the former character, and it follows, of necessity, that it must fall under the latter category.

ADCOCK'S SPRAY PUMP.—REPLY BY MR. ADCOCK TO CASSEL MORLAIS, AND OTHERS.

Sir,—Your correspondent, "Cassel Morlais," has attacked my patented invention with much bitterness of feeling; and writes *pseudonymously*, as even he, I presume, would blush to append his name to statements so diametrically opposed to the facts. "Cassel Morlais's" statements are as follows:—

Diameter of blast-cylinder.. 48½ and 50 in.
Number of double-strokes per minute, of 6 each 20
Average quantity of water flowing into the pit, per minute ...... 18¼ gallons.
Height of the lift of water by the spray pump .... 20 feet.
Water, expressed in horses'-power, raised per minute.................. 4
Horses'-power employed to raise it..... 54

Having thus tabulated the statements of "Cassel Morlais," that they may be easy of referenee during the following investigations, I, sir, with your permission, will now proceed to refute them, beginning with the horses'-power.

In the iron trade, where blast-cylinders are mostly used, it is customary, as stated by your correspondent, "Fair Play," to make the diameter of the blast twice the diameter of the steam-cylinder. Hence, the diameter of the blast-cylinder at Llanhiddel, being 50 in., it would, under ordinary circumstances, require to work it, a 25-in. steam-cylinder; and this latter would be rather more than 21 horses'-power.

The average pressure of the air at the iron-works, is 2¾ lbs. per square inch; at Llanhiddel, the highest working pressure is 4 lbs., and the average about 3½ lbs. To work, therefore, the 50-in. blast-cylinder to that pressure, under similar modes of consideration, would require of steam-power 30 horses.

$$\text{For, } \frac{21 \text{ H.P.} \times 4 \text{ lbs.}}{2\tfrac{3}{4} \text{ lbs.}} = 30 \text{ H.P.}$$

In corroboration of this, and to prove that the amount of power here given is amply sufficient, it may be necessary for me to remark, that the blast-cylinder, now at Llanhiddel, was worked to 4 lbs. per square inch, with 20 double-strokes of 6 ft. each per minute, by a 28-in. low-pressure condensing engine; and that an engine of that size is 26½ horses'-power.

To leave nothing to conjecture, however, I will now prove, that engineers and ironmasters have sound practical reasons, for thus proportioning the blast-cylinder to the steam-cylinder.

A blast-cylinder, twice the diameter of the steam-cylinder, contains four times its area. Hence, as the pressure of air on the blast-piston is 2¾ lbs. per square inch at the iron-works, the pressure of steam on the steam-piston, to balance it, will be 2¾ lbs. × 4 = 11 lbs. Now, a good condensing steam-engine derives 13 lbs. of power from the vacuum of the air-pump, and 6 lbs. from the

steam beyond atmospheric pressure; making, together, 19 lbs. on the steam-piston. Hence, there is a surplus amount of power on the steam-piston, equal to 8 lbs. per square inch, to overcome the friction, etc., etc., of the engine and blast-piston; which, I flatter myself, is amply corroborative of the correctness of the proportions assigned by the engineers and ironmasters, and of the justness of the statements I have made. But I again repeat, that the blast-cylinder, 50 in. diameter, now employed at Llanhiddel, was, in Staffordshire, worked by a 28-in. low-pressure condensing engine. The engine had been previously used as an old "*whimsy*," for winding coal; and, from the small diameter of its steam-pipes, its angles, bends, and contracted passages, it worked, as "Fair Play" has justly remarked, much below the power that a steam-cylinder of such size should do.

Having, sir, thus endeavoured to elucidate the power absorbed from the steam-engine by the blast-cylinder at Llanhiddel, I will next attack the equally erroneous statements of "Cassel Morlais," as to the amount of duty performed.

To do this in the most effectual, and in the most satisfactory manner, I shall select the time of the public exhibitions; and I do so for the following reasons:—1. The spray pump only was then worked.—2. The pit was full of water to the adit, by which I had an opportunity of admitting through the slits, and of discharging by the spray pump, not only the quantity of incoming water per minute, but an additional quantity from that reservoir, or head.—3. And most essentially, because several scientific and practical gentlemen were then present, who will now be able to compare the statements of "Cassel Morlais" with my own, and perceive the correctness of the latter.

Prior, however, to entering upon these details, it may be necessary for me to observe that, with the view to depreciate my invention, "Cassel Morlais" has endeavoured to make it appear, that the blast-cylinder, at Llanhiddel, absorbed from the steam-engine very considerably more power than it did; and that, from the same motives, he, on the other hand, has given mis-statements, wilfully lessening the quantities of water raised.

"Cassel Morlais" asserts that his "memoranda were taken on the spot, and in the presence of several gentlemen connected with the mining interest of Monmouthshire;" and proceeds thus: "Section of the pit, 240 ft.; depth of water blown up in 8 minutes, 2 ft. 6 in.; supposed height to which the water in the pit would have risen in the same time, 1 ft.—making a total depth of 3 ft. 6 in., which, multiplied by the section of the pit, gives 840 cubic feet of water blown up to a mean height of 20 ft. in 8 minutes—which, by calculation, is barely equal to 4-horse power."

(*To be concluded in our next.*)

ELLERMAN'S DISINFECTING AND DEODORISING PROCESS.

Some experiments have been made at Hackney to test the efficacy of Mr. Charles F. Ellerman's disinfecting process, in the presence of several medical men, besides the Guardians and many influential inhabitants of Hackney. It was perfectly successful, so far as could be ascertained by the sense of smell. Upon a collection of night-soil, yielding an almost unendurable fœcal smell, was poured a comparatively small quantity of the fluid; which had the immediate effect, on being thoroughly circulated, of banishing the foul smell, and imparting that which is peculiar to the re-agent itself, somewhat resembling the odour effused by a solution of nitrous acid. The "disinfecting" properties of the re-agent could not of course be ascertained from the experiment. The deodorized matter was afterwards subjected to further treatment by Mr. Redwood, a professional chemist. He poured upon it a phialful of bisulphuret of carbon, and restored to it its original fœcal odour, in order again to test the chemical properties of the re-agent. The re-agent was again applied, and with the same satisfactory result—neutralized the bisulphuret of carbon, (which in the gaseous form is evolved by the decomposition of animal matter,) and deodorized the night-soil. This experiment was repeated in a pail of clean water, to which the foul odour was imparted by the bisulphuret of carbon, and removed by the application of the re-agent. Mr. Redwood next threw into the deodorized night-soil some phosphoret of calcium; upon which combustion instantly took place, showing the immediate action of the re-agent upon the test.

Mr. Ellerman has sent a letter to the *Times*, expressly declaring that his process was never intended to supersede the removal of refuse, but only to destroy the odious exhalations, to mitigate the immediate ill effects, and to facilitate removal.

CAPTAIN GEORGE SMITH'S (R. N.) MARINE LIFE AND PROPERTY PRESERVER.

[Registered under the Act for the Protection of Articles of Utility.]

Captain Smith has already taken high rank among the friends of humanity by his well-known paddle-box safety-boat, now in such general use in sea-going steamers. The present is another apparatus of his invention, having also in view the protection of life and property at sea. It bears at first sight a resemblance to the well-known "Nautilus," but is distinguishable from it in two respects —first, in its greater simplicity, and consequently (we presume) greater cheapness; and second, in its affording a person cast adrift the means not only of keeping his person afloat, but of carrying along with him any portable articles of value or convenience—as biscuit, dispatches, paper, money, jewellery, &c. Critics have wondered what the celebrated bag of Æolus could have contained to induce the companions of Ulysses to untie it. "What occasion," says Pope, "was there to unbind the bag, when they might have satisfied their curiosity that there was *no treasure* in it from the *lightness* of it?" Behold the mystery unravelled. The bag of Æolus could have been nothing else than an early, and, no doubt, rude edition of Captain Smith's Life and Property Preserver—an apparatus which contained both wind (or air) *and treasure*. We are the more confirmed in the accuracy of this conjecture, when we refer to the exact words made use of by the poet in describing the gift of the bag from Æolus to Ulysses. Translated literally into English, the passage runs thus:—"He gave us the bag that it might *bear the vessel as well as ourselves*." An air-bag, no doubt, it was which might either be attached to the vessel or to the person, as occasion might require—as is the case also with Captain Smith's Preserver. Longinus is pleased to cite the whole of this story of the bag as a specimen of ingenious trifling; but all that we can, or ought to, deduce from this, is, that the true character of the gift to Ulysses had been lost sight of in the course of ages, and had remained shrouded in obscurity, even from the days of the "great Hippotades," of Æolia, the first inventor of air-bags, to those in which the great Mackintosh, of London, restored them to the arts and to *humanity*.

But to the immediate subject of this notice:—Captain Smith's Preserver consists of an air and waterproof case, capable of being expanded or contracted at pleasure. Fig. 1, is an external view of it in its expanded state; and figs. 2 and 3, are plans of the two ends. A A, is a flexible cover, composed of either caoutchouc or gutta percha, or of some of the compounds or preparations of these substances, in a sheet state; or of some textile fabric rendered air and waterproof by a coating of the same. It may be made either of the oblate oval form shown in the engravings, or of a circular, or of any other convenient form. B B, are a series of hoops of a form corresponding to that of the cover, which are made of any thin metal, or wood, or gutta percha, or some other suitable substance, and are made fast to the cover on the inside, at equal distances apart. C, is the main lid, through which the portable articles are introduced; when unfastened, it is kept attached to the case by a small chain, *b*. D, is a small cap at the opposite end to C; which cap only need be opened when it is merely desired to inflate the apparatus for the purpose of preserving the person. The inflation is effected simply by the opening of either or both of the covers to the atmosphere, and then closing the same.

The case may consist either of one hollow receptacle reaching from end to end, or it may be divided vertically into two compartments by the insertion of an air-tight diaphragm at or about the middle; say, for instance, at *m*, (fig. 1.) Again, instead of the case consisting of one longitudinal hollow receptacle only, it may consist of two or three, such receptacles, joined together, each having its own cover, hoops, lid, and cap. F F, are cords by which the apparatus is tied in front round the waist; and G, a strap which is brought from the front round the neck and made fast to F F.

Figs. 4 and 5 exemplify the application of the apparatus to a life-boat. A A, are inflated cases of the same simple construction applied to the inside of the boat; and B B, similar cases applied to the outside. Captain Smith, who has given the name of "Orion's Belt" to his preserver, is the original inventor of self-inflating air-cases, which he applied to Admiral Bouvrie's gig, in 1840.

Fig. 1.

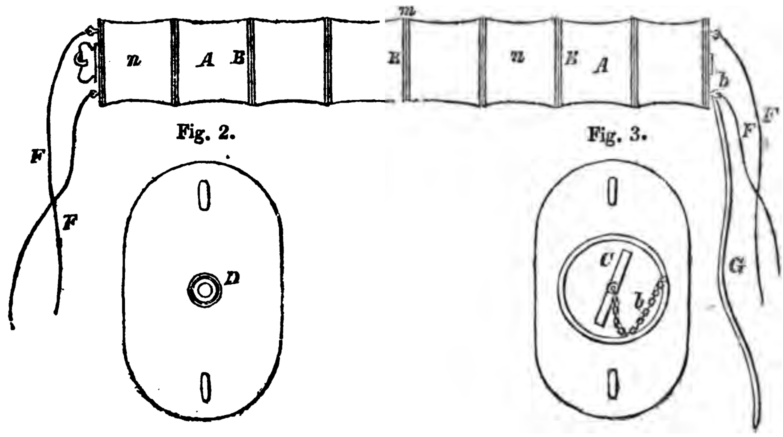


Fig. 2.

Fig. 3.

Fig. 4.

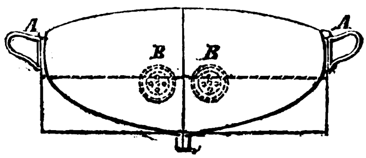
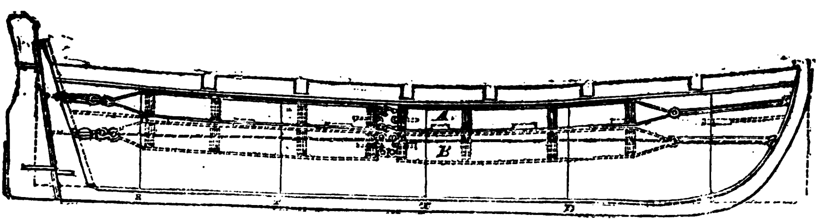


Fig. 5.



ON THE PROCESS OF THE METHOD OF VANISHING GROUPS. BY JAMES COCKLE, ESQ., M.A., BARRISTER-AT-LAW.

The Method of Vanishing Groups forms the subject of an article by me in the *Cambridge and Dublin Mathematical Journal* for the present month. It was not, however, until some time after I had written that article that I employed the above name to designate the Method. The object of this paper is to illustrate the PROCESS OF REDUCTION, by that Method, of a general quadratic function of three variables, and, hence, to suggest the process for quadratic functions of a greater number of variables.

PROCESS OF REDUCTION.

$$
\begin{array}{cccccccccc}
x^2 & yx & zx & x & y^2 & zy & y & z^2 & z & 1 \\
p & c & d & f & a & e & g & b & h & i \\
 & & & & \cdot & \cdot & \cdot & \cdot & \cdot & \cdot \\
 & & & & 4p & & & & & \\
\hline
 & & & & \mathrm{a} & \mathrm{e} & \mathrm{g} & \mathrm{b} & \mathrm{h} & \mathrm{i} \\
 & & & (-) & c^2 & 2cd & 2cf & d^2 & 2df & f^2 \\
\hline
 & & & & q & \mathrm{E} & \mathrm{G} & \mathrm{B} & \mathrm{H} & \mathrm{I} \\
 & & & & & & & \cdot & \cdot & \cdot \\
 & & & & & & & 4q & & \\
\cline{8-10}
 & & & & & & & \mathrm{B} & \mathrm{H} & \mathrm{I} \\
 & & & & & & (-) & \mathrm{E}^2 & 2\mathrm{EG} & \mathrm{G}^2 \\
\cline{8-10}
 & & & & & & & r & H & I \\
 & & & & & & & & & \cdot \\
 & & & & & & & & & 4r \\
\cline{10-10}
 & & & & & & & & & J \\
 & & & & & & & & (-) & H^2 \\
\cline{10-10}
 & & & & & & & & & s \\
\cline{10-10}
\end{array}
$$

Let
$$2u = 2px + cy + dz + f;$$
$$4v = 2qy + \mathrm{E}z + \mathrm{G}; \text{ and } 8w = 2rz + H;$$
then the foregoing process enables us to reduce the function
$$px^2 + ay^2 + bz^2 + cxy + dxz + eyz + fx + gy + hz + i \ldots\ldots [\mathrm{F}]$$
to the form
$$\frac{1}{p}\left\{u^2 + \frac{1}{q}\left[v^2 + \frac{1}{r}(w^2 + s)\right]\right\}$$

To such as may be familiar with my "Chapters on Analytical Geometry," now in course of publication in the present work, the following explanatory remarks may not be unwelcome; to such as are not, they will prove, perhaps, indispensable:

(1.) If each member of the first line of the above "Process" be multiplied into the quantity immediately below it, the algebraic sum of these products is the function whose reduction is effected. In the present case that function is [F].

(2.) When negative signs occur they are to be written in the second and not the first line of the Process; thus, if we have $-cyx$, we write $-c$ and not $-yx$.

(3.) The coefficient a and those to the right of it are to be multiplied into $4p$. I have placed a dot (·) under the quantities to be multiplied. In the present instance $\overset{a}{\underset{4p}{\cdot}}$ denotes an operation which might be represented by $a.4p$; in both cases the dot is the symbol of multiplication.

(4.) The fourth line represents the results of this multiplication.

(5.) The fifth line is the square of the coefficient of x in the given function. It is obtained readily from the three quantities ($f, d, c,$) immediately on the left of a.

(6.) The sixth line is the algebraic difference of the fourth and fifth; the latter being subtracted from the former. This is intended to be pointed out by the $(-)$ before the fifth line.

The subsequent operations are the same, *mutatis mutandis*.

(7.) As to the seventh, eighth, ninth, and tenth lines, see (3), (4), (5), and (6), respectively: these last four paragraphs will also afford a key to the eleventh, twelfth, thirteenth, and fourteenth lines of the Process respectively.

Were a quadratic function of any number of variables greater than three proposed for reduction, we might reduce it by a similar process continued to a sufficient length. The nature of the $(3+4\times n)$th line will be explained by (3), that of the $4(1+n)$th by (4); that of the $(5+4\times n)$th by (5); and that of the $(6+4\times n)$ by (6): n being unity or any greater integer consistent with the case.

If, in [F], p be a square and c, d, and f, be each divisible by $2p$, the multiplication into $4p$ may be dispensed with, and a process substituted similar to that which I employed in treating the Example at page 322 of the last volume of this work. So if p be of the form mn^2 and c, d, and f, be each divisible by n, a simplification will be introduced. Our first multiplier will then be $4m$. Again; when c, d, and f, are multiples of 2 we may omit the factor 4; the process will then be as in the first Example of the eighth of my "Chapters on Analytical Geometry," (*supra*, page 451.) The same remarks apply to q and r as to p; and to E, G, H, as to c, d, and f. So, if the given function involved more than three variables.

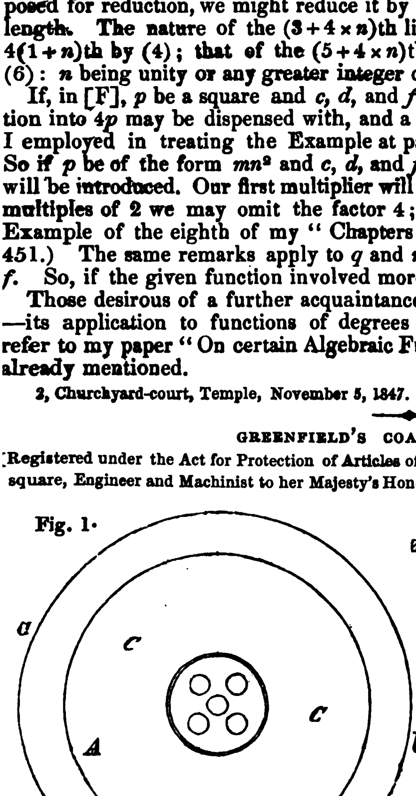
Those desirous of a further acquaintance with the Method of Vanishing Groups—its application to functions of degrees higher than the second, &c.,—I would refer to my paper "On certain Algebraic Functions" in the contemporary periodical* already mentioned.

2, Churchyard-court, Temple, November 5, 1847.

GREENFIELD'S COAL CELLAR-PLATE.

[Registered under the Act for Protection of Articles of Utility. John Greenfield, of Broad-street, Golden-square, Engineer and Machinist to her Majesty's Honorable Board of Ordnance. Inventor and Proprietor.]

Fig. 1.



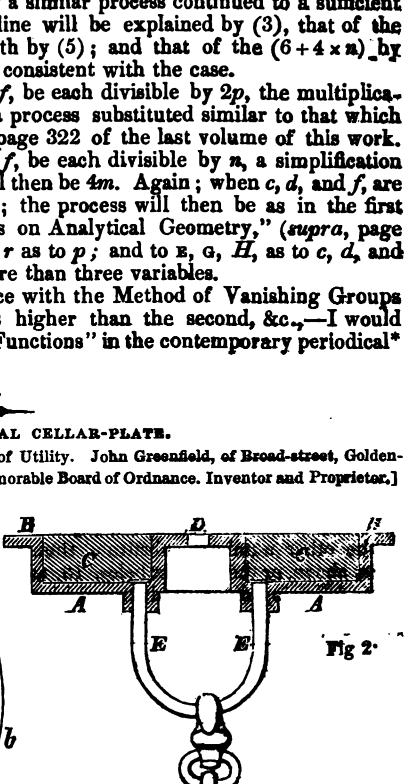


Fig 2.

This is a great improvement on the rdinary cellar-plate. Fig. 1, is a top lan of it; and fig. 2, a cross section on he line, a b, of fig, 1. A, is the body f the cellar-plate; B, B, the flange, y which it rests upon the pavement. The annular recess, C, C, is filled with vood, asphalt, or other like substance, ipon the surface of which the feet of passengers are not so apt to slip as upon cellar-plates made wholly of iron. From the peculiar shape of the plate it is not liable to tip up. D, D, are holes for the admission of light, and also for ventilating the cellar over which the cellar-plate is placed. E, is the eye to which the fastening-chain is affixed.

* The paper in question will be found at pages 267—273 of vol. ii. of the *Cambridge and Dublin Mathematical Journal* (No. XII., *Nov.*, 1847.)

The properties of what are called magic squares have naturally attracted the notice of arithmeticians. Various rules have been offered for their construction; and not long ago a German professor (Mollweide) published a mathematical treatise on the subject. The small use which has been made of them, renders it doubtful whether they deserve so much time and attention as some have bestowed upon them: they have, however, properties which may well claim a passing attention from those who are hastening to more important speculations; and I venture to promise that by means of a very simple device, properties will appear which have escaped the observation of former writers, and some of the properties already known will be placed in a clearer light.

17	24	1	8	15
23	5	7	14	16
4	6	13	20	22
10	12	19	21	3
11	18	25	2	9

In the above magic square of five, let us substitute a cipher for 13, (the arithmetic mean between 1 and 25) and for the other numbers substitute their excess above, or their defect below 13, as in the following diagram, distinguishing the defective numbers by the negative sign:

4	11	−12	−5	2
10	−8	−6	1	3
−9	−7	0	7	9
−3	−1	6	8	−10
−2	5	12	−11	−4

This process discloses to the most cursory observer several singular properties, and beautifully exhibits the symmetry which prevails in the different parts of the square.

It is scarcely necessary to remark, that, as each line, vertical, horizontal, and diagonal of the first square amounts to the same sum, 65, the positive and negative numbers must balance, and when brought into an equation will be nothing; as, $4+11-12-5+2=0$.

But I would more particularly beg the reader to observe,

1st. That each line whether taken vertically or horizontally (except the middle) *has its conjugate*, consisting of the same numbers with different signs. The 1st vertical pairs with the 5th, and the 2nd with the 4th.

$$4+10-9-3-2 \qquad 2+3+9-10-4$$

$$11-8-7-1\ \ 5 \qquad -5+1+7+8-11$$

2ndly. Of the *middle* vertical, one-half is conjugate to the other,

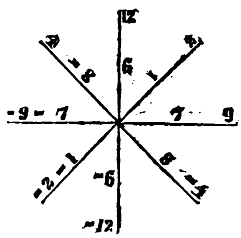
$$-12-6 \quad 0 \quad +6+12$$

The same is true of the *horizontal* lines, as may be seen on inspection.

The *diagonals* are like the middle lines:

$$\begin{array}{ccccc} 4 & & & & 2 \\ & -8 & & 1 & \\ & & 0 & & \\ & -1 & & 8 & \\ -2 & & & & -4 \end{array}$$

In short, all the lines which pass through the centre, vertical, horizontal, and diagonal, have this property; and if their halves are called radii, we may say each radius has its conjugate in the same straight line.



3rd. The transverse lines, by which I mean the lines parallel to the diagonals, are also conjugate.

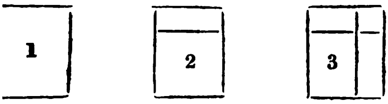
$$\begin{array}{rcl} -3-7-6-5 & : & 5+6+7+3 \\ -9-8-12 & : & 12+8+9 \\ 10+11 & : & -11-10 \\ 4 & : & -4 \end{array}$$

$$\begin{array}{rrrcrrr} & & 2 & . & -2 & & \\ & -5 & 3 & . & -3 & 5 & \\ -12 & 1 & 9 & . & -9 & -1 & 12 \\ 11- & 6 & 7-10 & . & 10-7 & & 6-11 \end{array}$$

4th. In addition to all this, we may observe that each cell has its conjugate: that is, there is the same number, but with a different sign occupying a similar position in reference to the centre. And if we imagine a rod stretched across the square, and twirled round the centre as on a pivot, its extremities and the

nearer parts equidistant from the centre will fall on the same two numbers, the one being in excess, the other in defect of the near number. As it traverses round (if I may pursue the metaphor which designates the square) it seems a nagician's wand moving in a magic circle rather than a magic square. In hort, the whole of the figure, whether onsidered as circle or square, presents n all directions a multitude of symmeries extremely curious, striking, and eautiful.

Another very curious property apears from the same process. In magic quares *duly* constructed, (this phrase vill be explained hereafter,) the conjugates are grouped with great regularity in geometrical forms according to he position of the cypher. The forms re three:



No. 1, is the form of the square which we adduced before, having the cypher in the centre, and one system of conjugates occupying the whole square.

No. 2, comprehends the cases in which the cypher is in any part (except the centre) of the *middle* bands whether vertical or horizontal.

No. 3, comprehends the cases in which the cypher occupies any other part of the square.

The parts into which No. 2 and No. 3 are divided differ in their relative magnitude respectively, in proportion as the cypher recedes from the centre.

Examples.

For No. 1, inspect the square already given.

For No. 2, the first specimen has the cypher one remove from the centre; the second, two. The ratio of the first parallelograms in the first being 3 : 2, in the second 4 : 1.

−9	−1	12	− 5	3
−3	5	−12	1	9
−2	11	− 6	7	−10
4	−8	0	8	− 4
10	−7	6	−11	2

10	−7	6	−11	2
−9	−1	12	− 5	3
−3	5	−12	1	9
−2	11	− 6	7	−10
4	−8	0	8	− 4

If each side of these squares in succession were made a base, we should obtain nstances of every position of the cypher which belongs to No. 2. For No. 3,

2	−4	−10	− 9	3
10	4	− 2	− 3	−9
−7	−8	11	5	−1
6	0	− 6	−12	12
−11	8	7	1	−5

−11	8	7	1	−5
2	−4	−10	9	3
10	4	− 2	− 3	−9
− 7	−8	11	5	−1
6	0	− 6	−12	12

8	7	1	−5	−11
−4	−10	9	3	2
4	− 2	− 3	−9	10
−8	11	5	−1	− 7
0	− 6	−12	12	6

Also by placing these squares in succession on each of their sides as a base, we have all the positions of the cypher belonging to No. 3.

Squares of *seven* have the same properties, but as there is more room for varying the position of the cypher, the relative magnitudes of the minor squares and parallelogram will be varied in proportion.

Three specimens of the form No. 2, of the square of seven, and two of the form, No. 3, are subjoined:

−11	−10	− 2	6	14	22	−19
7	15	23	−18	−17	− 9	− 1
−24	−16	− 8	0	8	16	24
1	9	17	18	−23	−15	− 7
19	−22	−14	− 6	2	10	11
− 5	3	4	12	20	−21	−13
13	21	−20	−12	− 4	− 3	5

− 4	14	−17	8	−23	2	20
−12	6	−18	0	18	− 6	12
−20	− 2	23	− 8	17	−14	4
21	−10	15	−16	9	−22	3
13	−11	7	−24	1	−19	− 5
5	−19	− 1	24	− 7	11	−13
− 3	22	− 9	16	−15	10	−21

−24	16	8	0	8	16	24
1	9	17	18	−23	−15	−7
19	−22	−14	−6	2	10	11
−5	3	4	12	20	−21	−13
13	21	−20	−12	−4	−3	5
−11	−10	−2	6	14	22	−19
7	15	23	−18	−17	−9	−1

−21	−20	−12	−4	−3	5	13
−3	4	12	20	−21	−13	−5
−22	−14	−6	2	10	11	19
−9	17	18	−23	−15	−7	1
−16	−8	0	8	16	−24	24
15	23	−18	−17	−9	−1	
−10	−2	6	14	22	−19	−11

−8	−16	−24	24	16	8	0
23	15	7	−1	−9	−17	−18
−2	−10	−11	−19	22	14	6
−20	21	13	5	−3	−4	−12
4	3	−5	−13	−21	20	12
−14	−22	19	11	10	2	−6
17	9	1	−7	−15	−23	18

I subjoin a few remarks by way of scholia on the specimens adduced:

First, It is amusing to observe how the cypher, which, in its central position exercises an influence over every part of the square, gradually loses its importance as it recedes towards either of the sides. One portion after another of its subject cells throw off their dependence and alliance, until at last the cypher is left in a corner, of no value or consideration, unguarded and alone.

Secondly, As long as the cypher retains any influence at all, it exercises it *doubly*, that is, on *pairs* of lines or half lines. It will not have a one-sided attendance. In the parallelograms, for instance, of the square of seven, of the form No. 2, the cypher has *two* conjugate lines on *each* side of it, or *one* or *half a one*. In the last of the form, No. 3, when it cannot have even half a one *on each side*, it has nothing.

Thirdly, It seems also worthy of remark, that though all the parallelograms, squares about the diagonal, and complements, form separate systems of their own, complete and distinct in their conjugates among themselves, nevertheless they all contribute towards the general object of the magic square, which is, making each vertical, horizontal, and diagonal, line amount to the same sum.

J.

MESSRS. DEANE, DRAY AND DEANE'S FARM FIRE-ENGINE, WATER, AND LIQUID-MANURE DISTRIBUTOR.

[Registered under the Act for the Protection of Articles of Utility.]

Fig. 1.

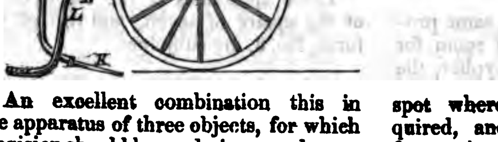
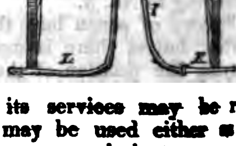
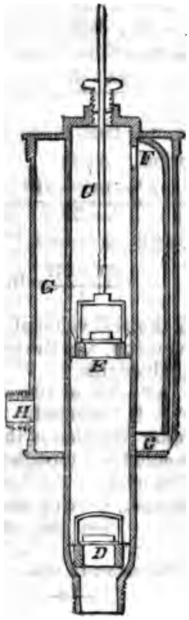


Fig. 2.



An excellent combination this in one apparatus of three objects, for which provision should be made in every homestead. Figure 1, is a side elevation, and figure 2, a back end elevation of it. It is mounted on wheels, in order that it may be readily moved to any spot where its services may be required, and may be used either as a fire-engine, or as an irrigator, or as a liquid manure distributor. A, A, is a vessel for containing the water or liquid manure, as the case may be. B, is a pump for lifting and distributing the

Fig. 3.



fluid contents of the vessel, A. An enlarged sectional elevation of this pump is given separately in fig. 3; C, is the barrel of the pump; D, the stop-valve; E, the bucket; F, aperture of communication between the pump-barrel and air-vessel, G, which forms an air-tight chamber around the barrel, C; H, is the aperture of discharge from the air-vessel, to which there is attached a hose-pipe, I, and nozzle, K; L and M, are suction-pipes, either of which may be used as the case may require, the communication of these pipes with the pump, B, being commanded by a cock, N; O, is the pump-handle, which is divided into two arms, P, P, at the end, to which the power is applied; R, R, stages and railing, on each side of the vessel, A, A, for the accommodation of the persons employed in working the pump.

When the machine is to be filled with the water or liquid manure, the supply is drawn up through the suction-pipe, L, by the pump, B, and discharged through the hose-pipe, I, into the vessel, A. The machine is then wheeled to the place of application, when the cock, N, is turned, so that the pump may now draw from the vessel, A, by the pipe, M, and distribute through the hose-pipe, I.

THE "PLUS AND MINUS PUZZLE."

Sir,—I think I can put your facetious correspondent, "J. E.," into a fair way of recovering the money out of which he has been cheated by means of the "plus and minus puzzle" of his ingenious friend. Let him unroll himself from the *heap* into which he was *struck* by the announcement that half a sovereign would pay both principal and interest for the loan of thirty shillings, and let him visit his friend "some fine morning" this "dreary dull November," and after having made *three* low bows *à la Français*, acquaint him that he has called respecting "that 'ere bit of a sovereign." However incredulous his friend may *seem* (for most people now-a-days *do seem* incredulous when money is wanted) on hearing this announcement, I conceive he will in the end be obliged to "cash up," if your correspondent argue somewhat in the following manner:

J. E.—"You say (page 475) that $A=2B$, and also that $AB=2B^2$?"

Friend.—"Of course I do."

J. E.—"Well, then, $B(A-2B)=0$, by transposition and resolution into factors. But this consists of the two independent factors $A-2B=0$, and $B=0$; the former of which is an absolute identity which we know to be *true*; but $B=0$ is a condition you have *artfully* introduced, and which you *knew at the time* to be *false* and inadmissible."

Friend.—"Well, and what of that?"

J. E.—"Why, your whole process is therefore true *only* on the supposition that $B=0$, and instead of proving that 10 shillings are the same as 30, you only prove that $A=A$, or that a sovereign is a sovereign; which is what *I know* to my cost."

Friend.—"But does not the 'Facetiæ Cantabrigenses' say the same as myself; and do you imagine a '*Cantab*' can be wrong?"

J. E.—"The 'Cantab' who made the 'puzzle' in the 'Facetiæ' had just returned from Newmarket at the time, and was desirous to make some old close-fisted uncle of his believe that his losses were only half what they really were; for when he says that $x^2=xy$, he just introduces the *same fallacy* of $x=0$, and instead of proving $2=1$, he only proves that $1=1$, or that *his losses* are equal to *his losses*, neither more nor less."

Friend.—"Then I perceive you expect me to '*pay up*?'"

J. E.—"I do, Sir, and speedily; or you may expect to be cited in the mathematical courts to answer the charge of algebraical swindling."

I suppose, Mr. Editor, your correspondent would have little difficulty in obtaining his missing sovereign (*provided his friend had one*) if he employed something like the arguments above; and I shall be happy to hear at an early opportunity whether my advice has had the effect of replenishing "J. E.'s" "lightened pocket."

I am, Sir, yours, &c.
THOS. WILKINSON.

Burnley, Lancashire,
Nov. 13, 1847.

Sir,—If the case is to be taken literally that "J. E." really took the 10s. as the liquidation of the debt of 30s., I can only say I am surprised at his folly, and think his "mathematical reputation" was not worth the money. If "J. E.'s" friend could prove, after a manner (certainly a very fallacious one) that 10s. = 30s., how is it that it did not enter "J. E.'s" mind that the same reasoning would show that 90 = 30, and ∴ his friend ought to pay him 4*l*. 10s. instead of 30s. "J. E." is perfectly correct in supposing the error arose from the equation being made of two expressions, each equal to 0, but is very foolish in laying the disgrace on algebra instead of on the right quarter. The equation

$$AB-2B^2=2B^2-AB$$

is in fact, $0=0$.

He then adds 0 to each side, and afterwards divides the equation by 0; it is this latter operation that introduces the absurdity. Each side of the equation becomes then (what is sometimes termed) a "vanishing fraction;" for by giving A and B their true values, we have,

$$\frac{0}{0}=\frac{0}{0},$$

which he should know require careful treatment to find out their true value (which may be finite, nothing or infinite,) and not unfrequently require the application of the differential calculus.

We will apply it in his equation; we have

$$\frac{A^2-AB-2B^2}{A-2B}=\frac{A^2-3AB+2B^2}{A-2B}$$

Now,

$$\frac{A^2-AB-2B^2}{A-2B}=\frac{0}{0},$$

where $A=2B$; differentiating this fraction with regard to A, we have,

$$\frac{2A-B}{1}=3B,$$

which is the true value of one side of the equation. Again;

$$\frac{A^2-3AB+2B^2}{A-2B}=\frac{0}{0}$$

when $A=2B$, as before,

$$\frac{2A-3B}{1}=B,$$

which is the real value of the other side of the equation, *i.e.* the equation is with its true values this,

$$AB=3B, \text{ or } 10s.=30s.,$$

which "J. E." allowed.

The other equation is the same thing, and I should have thought it would have opened his eyes to the former, as it is a very old catch, proving one = two.

I am, Sir, yours, &c.,
OSEG.

London, November 15, 1847.

NOTES AND NOTICES.

A New Planet, to which the French have no claim.—The following communication from M. Enck appears in the *Allgemeine Preussische Zeitung* of October 28th:—"That estimable astronomer, Mr. Hind, of London, discovered a new planet on the 18th of October, in the observatory of Mr. Bishop, in the Regent's-park, which he recognised as such because the star was not marked in the excellent chart of Professor Knorre, in Nicolajew (Academical Celestial Chart, Hora 4), and, because, moreover, the region of the heaven, intimately familiar to him from his own observations, had not previously denoted any star at that precise point. He was so sure of his discovery that he published it to the world after an observation of only four hours. The discovery of the planet (a star of the ninth magnitude) is somewhat difficult just at present, because the peculiar nature of the planet can only be recognised with any degree of certainty from its motion during a certain number of hours, and the planet, on the 25th of October, only moved at the rate of one minute per diem, or thereabouts. With the assistance, however, of Professor Knorre's chart, it will be possible to discover the new celestial visitant,—as it was speedily discerned in this city (Berlin) on the 24th, by Dr. Galle,—if the position of the planet, as ascertained by the meridian observation taken in this city on the 24th, (viz., 76° 2′ right ascension, and 13° 56′ northern declination), be adopted, and a daily retrogade motion for the next few days of from one to two minutes of right ascension, and a decrease of nothern declination to the extent of one minute daily, be assumed. Mr. Hind has given to his new planet the name of "Hora."

Composition Ornaments.—Thousands have admired the perfection of the figures produced by the looking-glass and picture-frame manufacturers, on the corners and other parts of their elegant gilt frames; but the art has been kept so close a secret among the craft, that not even the apprentices of the trade have been allowed to know the secret of this peculiar art, till near the expiration of their term of apprenticeship. We shall here describe the whole process as practised by the best burnish gilders at the pre-

ime. The composition becomes nearly as s stone, and the art will furnish an agreeable ment to many, who are not connected with ranch of business. Process:—Dissolve one of glue in one gallon of water; in another boil together two pounds of rosin, one gill of : turpentine, and one pint of linseed oil. ill together in one kettle, and continue the , stirring them together till the water has ated from the other ingredients: then add pulverised whiting till the mass is brought to nsistence of soft putty.—This composition : hard when cold; but being warmed it may ulded to any shape by carved stamps or ; and the moulded figures will soon become d hard, and will retain their shape and form permanently than carvings of wood. They e fastened with common glue on either plain es or mouldings.—*Scientific American.*

lge over the Ohio.—The plan of a bridge across hio, at Wheeling, has been agreed upon. It e supported by two towers on each bank, feet from centre to centre, 100 feet above the the river, and sixty above the floor of the .

rovements in Photography.—M. Niepce de St. finds, that if a sheet of paper on which there ing or printed characters, or a drawing, be ed for a few minutes to the vapour of iodine, here be applied immediately afterwards a g of starch moistened by slightly acidulated a faithful tracing of the writing, printing, or ig will be obtained. M. Niepce has also dis- d that a great number of substances, such as acid, phosphoric acid, chlorurets of lime and ry, &c., act in a similar manner,—and that s vapours, particularly those of ammonia, he effect of vivifying the images which are ed by photography.

Three Conjurors.—At the bottom shaft of olcoath mine (one of the deepest known), sors Airey, Whewell, and Sedgwick, were us to try some experiments where they could the pendulum at a great depth, and also at iderable elevation, and had their apparatus d to the bottom of the shaft, and after ng a portion of two or three days there, it acked up in an iron bucket, or *kibble*, with igs, into which a spark from a miner's candle have fallen; for when midway up the shaft iavings took fire, the rope was burned, the t fell to the bottom, and the apparatus was yed. The miners declared that nothing could burned the rope but the devil, and that the professors must be magicians. The day after was a violent storm, and these miners were eard saying, they were quite sure it was owing se men that had been underground; and one iat it must be the little *'un* (Professor Airey) e he *seed* him standing *with his back* against urchyard!

ine Glue.—The Lords Commissioners of the alty issued instructions in January, 1843, master shipwright of Chatham Dockyard, e the mainmast of the *Curacoa*, 24, then at that port, joined with marine glue, to test abilities for that purpose. The mast was ingly made of several pieces of timber joined er, under the immediate superintendence of effery, and when completed measured 28 in diameter, and 66 feet in length, and, when with the topmast, 90 feet 10 inches. The *oa* was soon after commissioned by Captain iomas Pasley, Bart., and proceeded to the American station, and after serving the period was ordered home and recently paid Sheerness. The vessel having been dis- d, their Lordships ordered that the mast be opened, as is usual after four years' ser- o ascertain its present condition. The master- right, Mr. Watts, at Sheerness Dockyard, in iance with their Lordships' order, set eight o work with sledge hammers and wedges to te the timbers, but their whole united efforts at one time failed in separating the joints, and only split the solid timber into large pieces. Mr. Watts then considered it best to have the mast cut into sections about eight feet long, for one piece to be transmitted to each dockyard, to satisfy the master-shipwrights that they were correct in their judgment when they assembled in committee and reported to the Government, that this invention was "one of the most valuable discoveries of modern days for ship-building purposes." On the mast being cut into pieces, it presented a most perfect and sound interior throughout, and the marine glue was as perfectly adhesive as a fortnight after its application. The foremast which was joined in the upper part in the usual manner adopted at the dockyards was found to be very rotten, the parts where the wet had entered and been retained yielding to the pressure of the hand like a piece of sponge, and in other places, where dry, crumbled into powder on being pressed. The original cost of a mast of the same dimensions as the mainmast of the *Curacoa* is upwards of £250; and now that it has been proved by upwards of four years' trial, that "made" masts joined with marine glue are equally serviceable after that period as when first made, the saving to the country would be very great were all the future made mainmasts for vessels and ships in the Royal Navy to be joined with that substance.

A New Gas Engine.—An engine on a new principle has been invented by a Mr. Perry, of Herkiman, and is now in operation at the store of Mr. Samuel Perry, in Front-street, near Whitehall, and evinces an astonishing power in proportion to the minute quantity of material from which the power is produced. The machinery consists, in part, of a cylinder, piston, pitman, flywheel and governor; in this respect similar to a steam-engine. A small quantity of spirits of turpentine is kept in a warm state, and the vapour arising therefrom is mixed with fifty times its volume of atmospheric air. A small quantity of this hydrogenated air is drawn into the cylinder and ignited by a movement of the machinery, producing a slight explosion, whereby the remaining air,—at least nine-tenths of the whole,—becomes so heated that it drives forward the piston with great force by its expansion. This engine is said to be capable of working ten horses power; and it is intended to substitute rosin instead of turpentine, which will reduce the expense of feeding it to about 50 cents. per day.—*New York Journal.*

WEEKLY LIST OF NEW ENGLISH PATENTS.

George Taylor, of 2, Bartholomew-place, Kentish Town, gentleman, for certain improvements in machinery or apparatus for sweeping and cleansing chimneys, funnels, flues, drains, and other places. November 13; six months.

James Chesterman, of Sheffield, machinist, for certain improvements in tape measures, and in cases used for containing the same, and in the machinery or apparatus for manufacturing or making such measures and cases, or certain parts thereof. November 13; six months.

George Price Simcox, of Kidderminster, for improvements in the manufacture of carpets and other similar articles. November 16; six months.

William Edward Newton, of Chancery-lane, for improvements in the mode or modes of manufacturing or preparing certain matters to be employed as pigments. (Being a communication.) November 16; six months.

George Phillips, of Park-street, Islington, chemist, for certain improvements in the purification of certain oils and spirits. November 16; six months.

William Birkmyre, of Southdown, Cornwall, for improvements in smelting copper and other ores. November 16; six months.

William Brunton, junior, civil engineer, of Pool, Cornwall, for certain apparatus for dressing ores or minerals. November 16; six months.

Peter Armand Lecomte de Fontainemoreau, of 5, New Broad-street, City, for certain improvements in manufacturing braids, plats, fringes-gimps, and other similar articles. (Being a com, munication.) November 18; six months.

Peter Armand Lecomte de Fontainemoreau, of 4, South-street, Finsbury, for certain improvements in the process and machinery for making, uniting, and preserving metallic and other tubes or pipes. (Being a communication.) November 18; sixmonths.

William Rocke, of Dudley, Worcestershire, for a new mode of treating and applying wrought iron. November 18; six months.

Alexander Parkes, of Birmingham, for improvements in the manufacture of metals, and in coating iron and steel. November 18; six months.

Thomas Martin, junior, of New Cross, Deptford, machine-maker, for improvements in the manufacture of drain-tiles and tubes, and other articles from plastic materials. November 18; six months.

WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

Date of Registration.	No. in the Register.	Proprietors' Names.	Addresses.	Subjects of Designs.
Nov. 11	1257	Deane, Dray, & Deane,	Arthur-street East, London-bridge, Ironmongers	Farm fire-engine and liquid manure distributor.
12	1258	John Braham	Bristol, Optician	Engineers' and surveyors' trigonometer.
„	1259	John Greenfield	Golden-square, Engineer and Machinist to Her Majesty's Hon. Board of Ordnance	Improved coal cellar-plate.
13	1260	Wm. Meredith & Son	Goswell-road	Spring for gentlemens' stocks, by which all fastenings are dispensed with.
17	1261	George Wright	Long-lane, London	Direction-label.
18	1262	James Erskine	Newton Stewart, Scotland, Gun-maker	Heel-plate gun safety action.

CONTENTS OF THIS NUMBER.

LONDON: Edited, Printed, and Published Joseph Clinton Robertson, of No. 166, F street, in the City of London.—Sold by A. W. Galignani, Rue Vivienne, Paris; Machin Co., Dublin; W. C. Campbell and Co., Hamb

Mechanics' Magazine,

SEUM, REGISTER, JOURNAL, AND GAZETTE.

1268.] SATURDAY, NOVEMBER 27. [Price 3d., Stamped, 4d.

Edited by J. C. Robertson, 166 Fleet-street.

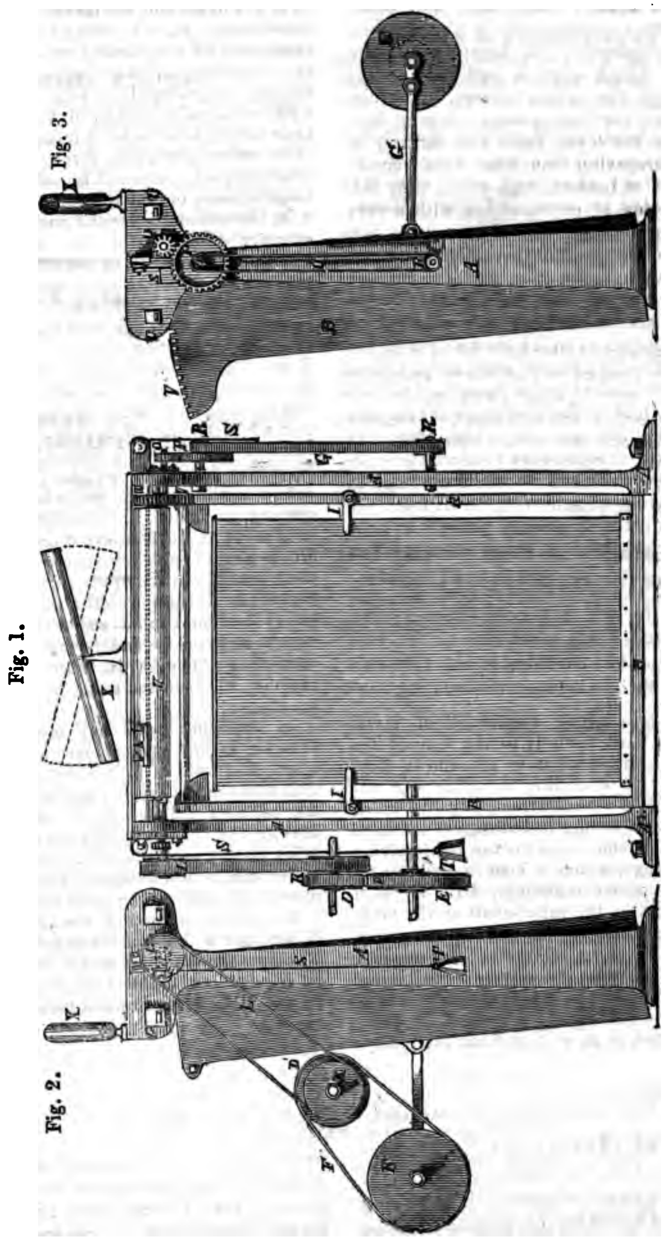


Fig. 1. Fig. 2. Fig. 3.

FIELDEN'S PATENT OSCILLATING CAN FOR THE RECEPTION OF COTTON SLIVERS, ROVINGS, ETC.

[Patent dated 8th May, 1847. Patentee, Joshua Fielden, Esq., of Waterside, Todmorden. Specification enrolled 8th November, 1847.]

When cotton, wool, flax, and other like fibrous matters are in the combed state, preparatory to being spun into thread, which state is variously designated by the terms slivers, ribbands, drawings, cardings, rovings, layers, &c., they are conveyed from the carding or other preparing machine into receiving cans or baskets, into which they fall in a series of convolutions with a very considerable degree of regularity. The object of the present invention is to cause the drawings (as Mr. Fielden, for the sake of convenience, calls in his specification, all matters in this combed or drawn out state) to lay themselves in the cans with still greater regularity, and at the same time to press them to a certain extent while in the course of laying and after they are laid; by which improvements, the drawings are rendered less liable to be stretched or made uneven, in the process of removing them from the cans, and the spinner is enabled to produce from them a much more perfect hread.

Fig. 1 is a front elevation of the machinery by which this is effected; and figs. 2 and 3 are elevations of the two ends of it. The following is Mr. Fielden's description:

A A, is a strong framework of metal which is fixed securely to the floor of the apartment in which it is set, and in close proximity to a carding or other like engine; B B, is a second frame of metal which oscillates or swings in bearings in the fixed frame, A A, and holds the can for receiving the drawings, which is kept in its place by the turn-button fastenings, I I; D, is a pulley fixed on the roller-shaft of the carding or other like engine, which gives motion to a second pulley, E, through the medium of a belt, F. On the spindle of this latter pulley, E, there is a crank which is connected by a rod, G, to the back of the oscillating frame, B B, so that when the pulley, E, is put in motion, the frame, B B, is made to oscillate. K, is a pulley fixed upon the same shaft of the carding or other engine as the pulley, D, which communicates by the belt and pulley, L L, a rotary motion to a pair of calender rollers, M M, which have their bearings in the fixed framework, A A: N is an eye, or guide, through which the drawings pass, and which is made to traverse longitudinally on the top rail of the frame, A A, (immediately over and parallel with the calender rollers, M M,) by means of the arrangements next to be described. O, is a pinion fixed upon the spindle of one of the calender rollers, M M, which gears into a larger wheel, P, which again gives motion to a belt, Q, running over two small pulleys, R R. To the outer edge of this belt there is attached one end of a cord, S, the other end of which is secured to the eye, N, so that while the end of the cord which is attached to the belt, Q, is descending, the eye, N, moves from left to right, (through the action of the cord, S,) but when it is ascending, the action of the weight, T, causes it to move in the contrary direction: U U, are a pair of pressing-rollers which have their bearings in the upper part of the fixed frame, A A, and receive an alternating rotary motion from a segmental rack, V, which is fixed to and forms part of the oscillating frame, B B, which gears into pinions, W W, affixed to the spindles of the pressing-rollers.

In operating with this machinery the drawing is first passed over a cylindrical beam, X, (made of thin sheet metal,) and then through the eye, N, and down between the calender rollers, M M, whereby the drawing is so consolidated as to admit of its being closely packed into the can and made better able to bear uninjured the subsequent process of withdrawing upon the can.

The parallel motion of the guide, or eye, N, together with the oscillating of the frame, B, causes the drawings to fall into the can in regular and uniform layers, while the rollers, U U, serve to press them down into the can.

GENERAL SIR SAMUEL BENTHAM'S PLANS FOR RENDERING WATER-WORKS SUBSIDIARY TO THE EXTINCTION OF FIRES.

Sir,—Means of connecting fire-extinguishing works with water-works seeming now an object of interest, the following account of works for this purpose, devised by the late Brigadier-general Sir Samuel Bentham, may perhaps be interesting to some of your readers; and his proposal for the introduction of analogous works

better security against fire of the
olis, may indicate a variety of de-
isential in the carrying such a
into efficient execution.

ong ago as 13th February, 1797,
nuel stated to the Admiralty, that
lering the immense losses which
een sustained in consequence of
'astation of repeated fires in his
r's dock-yard at Portsmouth,"
iow very ineffectual to the sup-
g fire among the inflammable
in a dock-yard, any quantity of
must be that can be thrown
ans of any of the engines in
ie proposed, in the first place,
tainment of an ample supply of
rater, for ordinary purposes, by
ting of deep wells, and the making
on that the water, in case of fire,
be applied, by means of a new
ement, to the speedy extinction of
flagration.

this purpose, he proposed that
hould be formed on the tops of
of the highest buildings in the
ard; that pipes of a large diameter
be laid from those reservoirs to
s of the yard where buildings of
ance were situated, or where ships
lie; that branches, prepared for
dy affixture of a hose, should rise
iose pipes, and from which, water
e thrown upon any building *with-
intervention of any fire-engine*,
ter being raised by pumps worked
team-engine. He also proposed
ing the pipes to the gun-wharf,
ctualling premises, the barracks,
ier public establishments, adding,
' the reasons for affording that
y to the naval establishments near
iouth, seem to apply equally to *all
establishments* in proportion to
nportance."

ad of mischiefs that might result
ie introduction of a steam-engine
iaval arsenal, he knew to be strong,
erefore confined his first proposal
very limited extent of apparatus
red to what he had in view; yet
ejudice against that *primum mobile*
ited a decision on the measure till
ddle of the following year. The well
ot completed before 1801, when,
mber 27th,) Sir Samuel proposed
il a system of fresh water deliver-
id fire-extinguishing works, so as
ivey water to every part of the dock-yard through pipes of eight and six inch bore; he further proposed a pump capable of forcing two tons of water per minute through those pipes to any part of the dock-yard, and to a height sufficient to throw that quantity of water over the highest building in the yard, or over the highest ship in the basin, on the slips, in dock, or at the wharf side; that pump to be worked by either of two 30-horse-engines in use night and day. The mains were so contrived that water could flow through them by each of two different courses, so that in case of accidental injury or stoppage in any part, the flow of water would still be uninterrupted in the other course: the 6-inch mains were so contrived that water could flow through them by two different courses to any part of the yard, so as to give a supply of water at any point to the full bore of the 8-inch main.

In case of insufficiency of fresh water, provision was made for supplying its place with salt water from the great basin.

Shortly after his return from his mission to Russia, he, on the 9th April, 1808, described to the Navy Board these works as then completed. The water kept in the high cisterns over the wood mills amounted to 320 tons; that in a lower cistern, for ordinary uses, to 90 tons. In the wood mills, on account of the inflammable nature of the refuse there, and because, in addition to this danger, the steam-engines for raising water were in the same building, he caused to be introduced in the interior of each room pipes, each prepared as for a hose, kept always in readiness to be screwed on, so as to be instantly available for throwing water with force on any point where fire might break out.

In addition to the power of the steam-engine, he, at the suggestion of commissioner Sir Charles Grey, devised a forcing-pump, to be worked by 30 men, from which the water should flow into the same pipes as from the engine-pump. The whole apparatus, with the exception of a standard to receive capstan-bars, was *under* ground, so as not to occupy valuable space in the yard.

It happened not to be before 25th June, 1810, that Sir Samuel had leisure to cause these works to be set in motion in his presence; the following note is copied from a journal written at the time:-

"The steam-engine working the forcing-pump, with four hose screwed on to four fire-plugs. The hose threw the water over the wood-mills, and thence over the chimney coming up from the blacksmith's shop over the reservoir."—"The horizontal distance to which the water was thrown was 110 feet from the nozzle, by measurement; by estimate it was thrown perpendicularly to a height of 60 feet, when a man stood on the ground to guide the pipe; but when the man took the pipe to the top of the wood-mills, the water was thrown to the height of 70 feet from the ground. Six hose can be worked at the same time."

Another circumstance noted seems of importance, namely, that on trial of a hose screwed on to a pipe at a very distant part of the yard, the jet was equal to that by the side of the wood-mills; from which it appears that the great loss by friction in passing far through ordinary hose, does not take place in a material degree when water is forced through well made metal pipes of large bore.

In Plymouth dock-yard, where Sir Samuel introduced works of the same nature, fresh water was delivered at a height which would command the important parts of the yard without the intervention of a steam-engine. The forcing-pump for raising water from the harbour, here, as at Chatham, was designed to be worked by from 60 to 80 men, whose force applied to the 16 bars of the capstan, at a pace of 2½ miles per hour, was calculated to raise a ton of water per minute, under an initial resistance equal to the pressure of a column of water of 200 feet.

The success of the water and fire-extinguishing works in those dock-yards, has led to the introduction of similar works in other naval arsenals. Sir Samuel proposed them on a very extensive scale for Sheerness; but on the abolition of his office, this was lost sight of, till Mr. Mitchell, the present engineer of that dock-yard, proposed and succeeded in introducing them. This gentleman was of Sir Samuel's establishment of millwrights in Portsmouth dock-yard, and by him was selected to superintend the erection of the water-works at Plymouth. While Mr. Mitchell was so occupied, an extensive conflagration broke out in the rope-house, on which occasion he noticed the great advantage of a large jet or *dash* of water in extinguishing fire over many small jets. The principal main he has laid at Sheerness is of 12-inch bore, instead of eight, as at Portsmouth; he has bestowed great attention on the pumps, air-vessels, and other appendages, and has provided hose even larger than those at Portsmouth. In other respects, the arrangements at Sheerness are of a similar nature with those at Portsmouth.

Sir Samuel was from 1814 many years absent from this country, but soon after his return he had the satisfaction to learn that on several occasions his fire-extinguishing works had been of eminent service when fires had broken out; and on the 26th June, 1827, the mechanist of Portsmouth Dock-yard wrote to him that his letter had been shortened in consequence of an alarm of fire in a ship along side the settle, but "the fire was very soon extinguished by means of the water pipes."

Several destructive conflagrations having taken place in London soon after Sir Samuel's return, his attention was drawn to the subject, and he drew up a proposal for the better protection of the metropolis against fire. He observed in his paper, that as in regard to Portsmouth dock-yard the efficacy no less than the economy of the works in question, depended on their being combined with the water-works, and with the steam-engines for manufacturing purposes, so in regard to the metropolis, works already existing might be made the basis of the plan he had to suggest.

He observed that most of the water-works of the metropolis had means of raising water to a reservoir high enough to force water in a jet from the mains as high as the first-floor of all houses, and to the second, and even third floors of those in the lower parts of the town,—That there were two ways by which this existing apparatus might be adapted to extinguishing fire; first, by an alteration of the fire-plugs in the streets, such as should enable hose to be screwed upon them, so that by this means water might be thrown in a jet as large as these plugs would furnish; secondly, by adapting in the front of every house where it might be thought desirable lesser screw-plugs ready for screwing on a hose. But as the reser-

would not force a jet over the tops
: higher buildings, water might be
n to that greater height by the
of the steam-engines, already exist-
t the several water-works, in the
way as is done by the steam-engines
:tsmouth.
: expense attendant on these im-
ments would consist in the altera-
of the plugs and the provision of
le hose. The large ones, he sup-
might be a public concern, so far
t the expense would be to be paid
by subscription amongst insurance-
, or included in the rate paid by
tants for the supply of water; but
aller plugs and hose being pecu-
applicable to each particular house,
first moment fire might be disco-
, the provision of this apparatus
be optional with each householder,
suitable hose, if desired, might be
led and kept on the premises them-

Samuel adverted to the many ex-
wells in town capable of affording
it supply of water; and observed,
for raising it steam-engines and
s were often on the spot, which by
ssion obtainable from the proprie-
might be connected with the gene-
stem of pipes, to act in addition to
paratus at the water-works.
said, that "in particular buildings
at value, or of a peculiarly hazard-
ture—such as libraries, manufacto-
nd theatres,—an apparatus might
roduced in the interior, such as is
described as existing in the wood-
So also at any time forcing-pumps
be applied to any of the several
: wells in the streets."
: General then proceeded, "that
er well-contrived and efficient such
m of fire-extinguishing works might
itself, there could be no dependance
l on it unless suitable regulations
dopted for insuring their prompt
rtain application to use in times of
' And referring to two great fires
had then recently occurred, "it was
ous," he said, "that the destruc-
such immense property had arisen
lelay in the arrival of fire-engines,
want of water after they did arrive,
om want of presence of mind and
ence in the persons first on the
that according to present arrange-
, an irremediable source of delay
in the procurement of water was, that the turncock of the division had to be waited for, before the plugs could be opened." To remedy this, means of turning on water should be in the hands of persons already on the spot—"such persons exist in the police."—"It may at first sight," he said, "bear the appearance of impropriety, or impracticability, that every police-constable should carry with him a turnkey; but in point of fact a policeman's staff, without being too cumbersome or heavy, might be made to answer this purpose; and if the very frequent occasions be called to mind when such delays have occurred to the great destruction of life and property, it may well be thought worth while not to reject a suggestion of this nature because it professes to effect an important purpose by very simple means."—"The larger hose and jets might be kept in appropriate receptacles, not too far apart, and openable by police-constables."

"Should street forcing-pumps be introduced, they, as at Portsmouth, should be *below* the pavement so as to be secure from frost; the means of working them might be by a capstan-post, with bars to put in in time of need, when men to produce an immense force could be easily collected."

In order to secure readiness for use, Sir Samuel thought that this system of works should be kept as much as possible in constant use for other purposes than extinguishing fire—for example, instead of sending carts about with water for watering streets, the fire-extinguishing hose might be employed for this purpose, and the business thus be effected at a much less expense than its present cost. He then observed, that it was desirable to introduce, and improve upon, a variety of minor apparatus used in foreign countries to preserve life and save property; and concluded by saying that the cost of carrying into execution such a plan as he had proposed would materially depend on the judiciousness of the means employed.

The above quoted letter, recommending the introduction of fire-extinguishing works in the metropolis, was by Sir Herbert Taylor, February 1830, communicated to Sir Robert Peel, and to other influential persons; but it was conceived that the Insurance Companies would oppose the measure, and altogether that

the public mind was not yet ripe for it. In the year 1844,—whilst the Bill was pending which Lord Lincoln brought into Parliament for the better Security of the Metropolis against Fires, Sir Samuel's widow took the liberty of submitting a copy of that letter to his lordship.

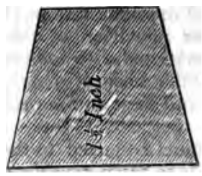
It may be hoped that the experience obtained in Her Majesty's dock-yards of the efficacy of such a system, together with the experiments lately made at Liverpool, may now be considered as convincing evidence of the increased security that would be obtained in the metropolis, by a judicious extension, on the same principle, of the existing water-works to the purpose of extinguishing fire.

B.

STATEMENT OF EXPERIMENTS MADE ON THE RELATIVE STRENGTH OF CAST-IRON, CHILLED AND UNCHILLED, AT CRANE-FOUNDRY, ON JULY 21, AND AUGUST 23, 1847.

I. *Experiments of July* 20.

The bars upon which the experiments were made were two in number, and were run at the same time from the same pot of metal. One of the bars was cast in the ordinary method of green sand-casting, and of the following dimensions:—Width of top edge, ½ an inch; width of bottom edge, 1 inch; depth, 1½ inch; total length, 4 feet: width between the supports when proved, 8 feet 10 in. area of cross section 1.125 inch; weight, 18½ lbs.



The chilled bar had exactly similar dimensions to the above; except that the width of the bottom edge was 15/16ths of an inch only, instead of 1 inch, this difference arising from the sudden cooling of the bottom edge, which was run upon a piece of cold iron in order to chill it, (the bottom edge being the only part chilled;) in consequence the area of the cross section was only 1.078, instead of 1.125, and the weight was 12 lbs, 13 oz. instead of 13½ lbs.

Number of Experiments.	Load carried by the bar. cwt.	qr.	lbs.	Deflection observed in decimal parts of an in. Unchilled bar.	Chilled bar.	Chilled bar deflects more than unchilled, by difference as under.	Remarks.
1	..	3	4	.0	.0	·0	All weights taken off, bars resumed their original position.
2	1	3	4	.0	.0625	.0625	
3	2	3	4	.0625	.1250	.0625	
4	3	3	4	.125	.2187	.0937	
5	4	3	4	.25	.3125	.0625	
6	5	1	4	.2969	.3437	.0468	
7	5	3	4	.3125	.406	.0935	
8	6	1	4	.3437	.4687	.1250	
9	6	2	4	Broke.	·5321		3 ins. from centre.
10	7	0	4		.5321		
11	7	1	4		Broke.		¾ of an inch from the centre.

As the chilled and unchilled bars are of different areas, and consequently of different strengths; it will be necessary before comparing them, in order to find the results produced by chilling, to reduce the weights they are capable of bearing to the standard of one or other of their areas. It will be most convenient to reduce the area of the unchilled bar to that of the chilled bar: and since

st-iron beams will carry nearly in on to their cross sections every se being the same, the strength chilled bar of the same area as ed bar will be found as follows:— area of the large unchilled bar iches is to the area of the smaller bar 1,078 inches, so is cwt. 6.28, ght borne by the large unchilled cwt. 6.01, the weight which would en borne by an unchilled bar of the same area as the chilled bar. But by the process of chilling, the small bar was made capable of bearing a weight of cwt. 7.035 instead of cwt. 6.01, the weight it would have borne had it not been chilled; and in consequence it results, that the process of chilling the under edge of the bar gives a superior strength of 17 per cent. on the cross section.

II. *Experiments of August* 23.

bars upon which these experiere made were all cast from the t of metal and at the same time; re four in number; viz.: No. 1, green sand; No. 2, in dry sand; cast in a *chill;* No. 4, cast in a d afterwards annealed.

The total length of each bar was 18 inches, and the distance between the supports in each case 15 inches.

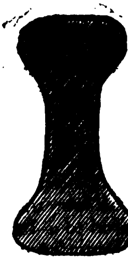
The figures below represent the sections of the bars, full size, as nearly as they could be taken:

No. 1.

No. 2.

No. 3.

No. 4.



TABLE, No. 1.

Col. 1	Col. 2.	Col. 3.	Col. 4.	Col. 5.	Col. 6.	Col. 7.	Col. 8.	Col. 9.	Col. 10.
Number of bar.	Weight of bar.	Area of section.	Weight, if reduced to same area as bar No. 1, ·46 in.; col. 3, col. 2, col. 4.	Densities of bars, taking bar No. 1 as standard, 32·5 is to col. 4 as 100, col. 5.	Weight actually borne by each bar.	Weight each would have borne if reduced to area of No. 1; .468 is col. 3, col. 6, col. 7.	Last column reduced to standard of 100, to show per centage.	Observed deflection or measure of elasticity.	Reduced to standard of 100.
	Ounces	Inches.	Ounces.	—	Lbs.	Lbs.	—	Inches.	—
1	32·5	·468	32·5	100·	1232	1232	100·	·130	100
2	30·5	·407	35·0	107·3	1008	1159	94·	·114	87
3	34·75	·428	37·9	116·7	784	857	69·5	·053	40
4	34·5	·444	36·3	111·7	2520	2656	215·0	·148	114

With regard to the formation of Table No. 1, there will be no remark necessary as it explains itself, excepting merely to observe that it appears from it that green sand castings are 6 per cent. better than dry sand, and 30½ per cent. better than chilled ones without annealing; and, lastly, that by the process of chilling and annealing, 115 per cent. is added to the strength of cast-iron in respect of ability to resist impact.

Although from the smallness of the bars experimented upon and their bad section for comparison with the experiments of others, yet the above are quite sufficient to show the vast superiority of cast-iron treated in the manner described for No. 4, and the advantage resulting may safely be looked upon as very little less than 100 per cent.

It may also be well to observe, that these experiments show that the density of cast-iron is by no means a criterion of its strength.

With regard to the table of experiments, the method adopted in order accurately to measure the deflection was by having a cord from the bar under trial passed over and secured to a brass drum exactly 4 ins. in circumference; from the centre of the drum-axle a large circle was described, the quadrant of which was divided into hundredths, and a pointer fixed on the drum consequently indicated with great nicety the most trifling deflection.

It may also be remarked that column 5 is the comparison of the deflection of bar No. 4 with Nos. 1 and 2 only: No. 3 not being a sample of common casting, and therefore not included in the average.

With regard to the microscopic appearance of the sections, No. 1 presents much the same appearance at the top as at the bottom of the section, excepting that in the lower part the fracture of the iron seems more open, but nothing like a crushed appearance is observed towards the top. The fracture in this bar is about a ¼ of an inch from the centre, and goes through nearly in a straight line and at right angles with the horizontal line.

No. 2. — With regard to this bar exactly the same remarks apply to it as in the case of No. 1, excepting that the fracture took place in the centre between the ends of the bar.

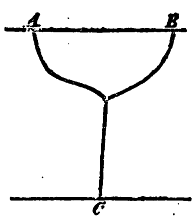
No. 3.—The fracture of this bar presents a very singular appearance; it is highly crystallized, and the granular structure instead of being homogeneous, as in the former cases, appears to be

made of crystallized threads radiating from the centre of the curves which form the profile of the section. An attempt to represent this appearance has been made in the engraving of this section (No. 3.) It broke with a straight fracture ⅞ths of an inch from the centre of the bar, and about a ¼ of an inch out of the perpendicular line in the width of the bar.

TABLE, No. 2.

Col. 1.	Col. 2.			Col. 3.				Col. 4.	Col. 5.	
Number of Experiments.	Load carried by bars.			Deflections observed in decimal parts of an inch.				Average deflection of No. 1 and 2.	Inferior deflection of No. 4, with same weight.	Remarks.
	cwt.	qr.	lbs.	No. 1.	2.	3.	4.			
1	1	0	0	·0	·0	·0	·0	·0	·0	
2	2	0	0	·02	·02	·005	·01	·02	·01	
3	3	0	0	·035	·035	·0175	·0225	·02	·013	
4	4	0	0	·05	·0525	·0236	·0365	·035	·015	
5	5	0	0	·065	·075	·0370	·0535	·051	·016	
6	6	0	0	·0775	· 0875	·0420	·065	·070	·017	
7	7	0	0	·09	·0975	·053	·0665	·082	·027	
8	8	0	0	·1025	·1084	Broke.	·0680	·093	·037	
9	9	0	0	·1125	·1140		·075	·105	·038	
10	10	0	0	·1213	Broke.		·08	·113	·041	
11	11	0	0	·13			·087	·121	·043	
12	11	2	0	Broke.			·09	·13		
13	12	0	0				·95			
14	12	2	0				·1			
15	13	0	0				·105			
16	13	2	0				·11			
17	14	0	0				·115			
18	14	2	0				·12			
19	15	0	0				·1285			*Weight re-
20	16	0	0				·1325			moved and
21	17	0	0				·14*			bar resumed
22	18	0	0				.12**			its horizon-
23	19	0	0				·125			tal line.
24	20	0	0				·13			** Weight
25	21	0	0				·141			put on again
26	22	0	0				·1475			and deflec-
27	22	2	0				·1480			tions pre-
28							Broke.			sented.

No. 4.—At the moment of fracture this bar broke in two places, the one a simple fracture about 5 ins. from the end and nearly at right angles to the plane of the bar, and the other a compound fracture about a ¼ of an inch from the centre, and represented in the adjoining figure; A, B, C, representing the line of centre fracture. The iron had completely lost the crystallized appearance of No. 3, and had resumed the granular structure of Nos. 1 and 2, excepting that the grains are much finer and look more like the fracture of cast-steel than cast-iron.



ROBERT BOWMAN.

GEOMETRY OF THE LINE AND PLANE.—BY T. S. DAVIES, F.R.S., & E., F.S.A., ROYAL MILITARY ACADEMY, WOOLWICH.

(Continued from p. 675.)

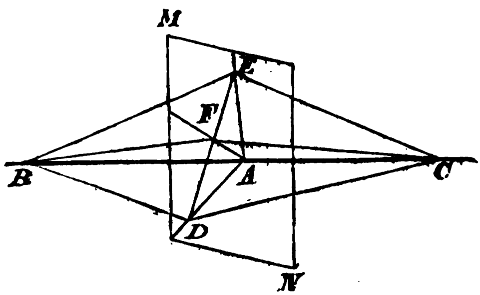
Chap. III.

Inclination and Perpendicularity.

PROP. XXIV.

If a straight line be perpendicular to a plane, it will be perpendicular to every straight line in that plane which passes through the intersection of the perpendicular line and plane.

Let BAC be a line cutting the plane MN in A, and making right angles with the two lines AD, AE in the plane MN; and let AF be any other line MN drawn through the point A: then BAF will be a right angle.



For make AB, AC on opposite sides of the plane MN equal, and take any points D, E, F in the lines AD, AE, AF, so that they shall be one line; and join BD, DC, BE, EC, BF, FC.

Then, since BA, AE are equal to CA, AE, and the angles BAE, CAE also equal (being right angles), we have BE equal to EC. In a similar manner BD, DC are equal. (*Euc. i.* 4.)

Again; since the sides BD, DE of the triangle BDE are equal to CD, DE of the triangle CDE, and the base BE to the base CE, the angle BED is equal to the angle CED, or BEF to CEF. (*Euc. i.* 7.)

Also, since BE, EF in the triangle BEF are equal to CE, EF in the triangle CEF, and they contain equal angles, we have BF equal to FC.

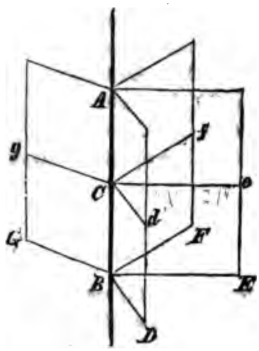
Lastly; since in the triangles BAF, CAF, we have the sides BA, AF equal to the sides CA, AF, and the base BF to the base CF; we have the angles BAF, CAF also equal. They are also adjacent angles, and therefore BC is perpendicular to AF.

PROP. XXV.

Through any point in a straight line, innumerable lines can be drawn perpendicular to it; and all these perpendiculars will lie in the plane which is perpendicular to the line at that point.

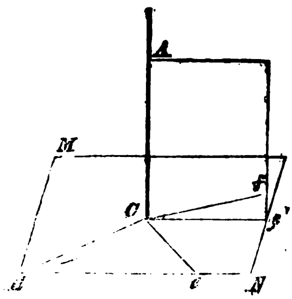
(1.) Through the point C in the given line AB, innumerable straight lines can be drawn, all of which shall be perpendicular to AB.

For since the line AB admits of innumerable planes AD, AE, AF, AG, *etc.*, being drawn through it (*ax.* 3.), and that in each of these planes perpendiculars C*d*, C*e*, C*f*, C*g*, *etc.*, can be drawn to the line AB at the point C, one in each plane, the first part of the proposition is manifest.



(2.) If it be denied that they are all in one plane, let MN be the plane which contains two of them. C*d*, C*e*; and let if possible another of the lines, C*f*, so drawn be above the plane, MN.

Draw the plane AC*f* cutting MN in C*f′*. Then (*prop.* 24) the angle AC*f′* is a right angle.



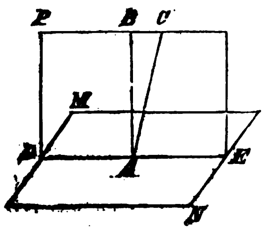
But by the assumption AC*f* is a right angle: and hence in the same plane A*f′* there are two right angles AC*f′*, AC*f* made with the same straight line, on the same side of it: which is impossible.

The line C*f* cannot therefore be out of the plane MN: or in other words the line C*f* is in the plane drawn through C*d*, C*e*. In the same way it is proved that all the specified lines are in the plane MN

PROP. XXVI.

From the same point there can only be drawn one line perpendicular to a plane, whether that point be in the plane or without it.

(1.) Let A be a point *in* the plane MN: there can be only one line drawn through A perpendicular to MN.



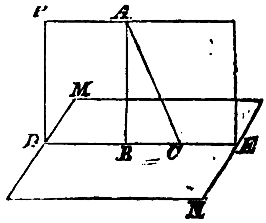
For if there can be more, let AB, AC, be two lines perpendicular to MN; and draw through them a plane BCEA cutting MN in DE.

Then since AB is perpendicular to the plane MN and AE a line in it, the angle BAE is a right angle. In the same way CAE is a right angle (*prop.* 24.) Whence the lines AB, AC in the plane BAE are both perpendicular to the line AE in that plane: which is impossible. Wherefore in this case, only one line can be drawn from A perpendicular to MN.

(2.) Neither can two lines be drawn from A (*above* or *below* the plane MN) perpendicular to that plane.

For if there can be two, let them be AB, AC, and draw the plane PE through them, cutting MN in DBCE.

Then (*prop.* 24) the angles ABC, ACB, of the triangle ABC are both right angles; which is impossible (*Euc.* i., 17.)



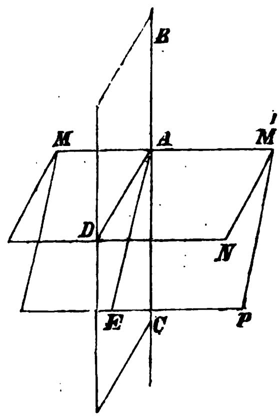
Prop. XXVII.

Through the same point there can be drawn only one plane perpendicular to a straight line, whether that point be in the line or without it.

(1.) Let the point A be *in* the line AC, then only one plane can be drawn through A perpendicular to BC.

For if there can be two, let them be MN, MP intersecting in MM′. Through BC draw any plane BD not passing through MM′, to cut MN, MP in the lines AD, AE.

Then since BC is perpendicular to both MN and MP, it is perpendicular to the lines AD, AE in them drawn through A (*prop.* 24); wherefore in the plane BD the lines AD, AE are both perpendicular to BC: which is impossible. Whence MN and MP cannot be both perpendicular to BC.

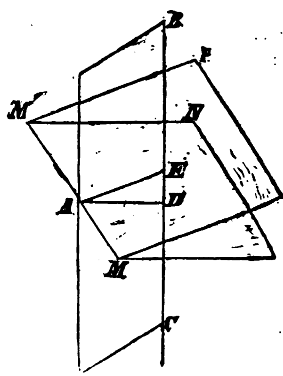


(2.) Let A be a point *without* the line BC: there can be drawn only one plane through A perpendicular to BC.

For, if possible, let there be two, viz., MN, MP. Through BC and A draw the plane BA cutting MN, MP in AD, AE.

Then EA is in the plane MP perpendicular to the line BC, it is perpendicular to BC. In the same way AD is perpendicular to BC; that is, two lines DA, EA in the same plane BA which meet in a point A are both perpendicular to the line BC: which is impossible.

More than one plane, therefore, cannot be drawn through the point A without the line BC perpendicular to BC.



ɔur recent notice of this ingenious :ion (*ante* p. 444) we described ıly of the patentee's arrangements; e now fulfil the promise we then to describe another, which seems to possess a great advantage over her.

Fig. 1.

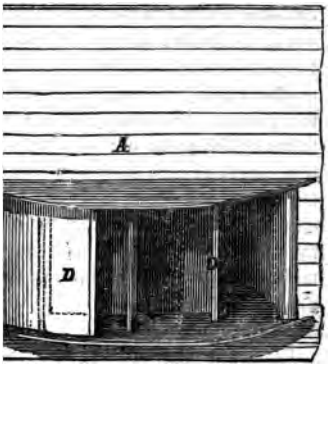
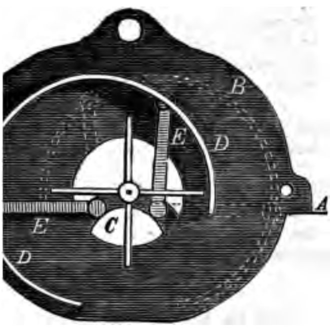


Fig. 2.



ıe former arrangement provision ɜ for the backing of the vessel, by ɼ a segment of the body of the case to open and shut by the action water, according as the vessel is forwards or backwards, and thereby to change from stern to stem, or *vice versâ*, the direction in which the water is ejected by the paddles. But by the plan we are now about to describe the body of the case is made in one entire piece, the whole of it is movable, and it is connected by two links to the top and bottom of the case, in such manner that by the pressure of the water forwards or backwards, the body of the case is immediately turned into the position most proper for driving the water in either direction. This is a great simplification of the first arrangement, and a very decided improvement. Fig. 1 of the annexed engravings is a plan of the propeller with this valuable modification, and fig. 2, an elevation of it. A, represents the side of the vessel; B, the recess which contains the propeller, C; DD, the body of the case; and E E, the connecting links.

We observe that Mr. Simpson has been making some more trials with his experimental vessel, the *Albion*, since that at which we had the pleasure to be present, and with similar success—the average speed attained, reaching generally to between 10 to 12 knots an hour. We cannot help thinking, however, that, with a vessel of better lines than the *Albion*—which, as we before observed, are excessively bad—a much higher speed than this ought to be realized. Even 10 or 12 miles an hour, however, is a great rate of speed for paddle-wheels to accomplish, with that entire absence of disturbance and vibration, for which this invention is pre-eminently remarkable. "Nothing assuredly," says the *Times*, "can be more beautiful than the noiseless and mysterious motion of Mr. Simpson's boat." We learn, from the same authority, that the diameter of the wheels in the *Albion* is only 24 inches; and that the wheels necessary for a boat of from 300 to 400 tons burthen, would not exceed 30 inches in diameter. If there be no error in these calculations, Mr. Simpson's propeller must prove a powerful competitor to both the common paddle-wheel and screw under a great many circumstances, but more especially in canals and narrow rivers, where not only injury to the banks, but the resistance of the banks to the progress of a vessel, has to be avoided.

The "Indicator," though it should be an inseparable companion to the steam-engine, is assuredly not so generally or so well understood as the engine itself; and it is not unfrequently neglected, solely from ignorance of its principle of action, and of the right mode of using it. The cause of this is, no doubt, the paucity of the information furnished respecting it in all the existing works on the steam-engine—the best of them not excepted. In *Bourne's Catechism*, (which we recently noticed with approbation, as being on the whole exceedingly satisfactory,) there is but a single paragraph devoted to the Indicator. The present treatise has been written with a view of remedying this prevailing defect, and by persons well qualified for the task. Mr. Main is the able Professor of Engineering at the Royal Naval College, Portsmouth, and Mr. Brown one of those valuable practical men whom a recent act of most judicious liberality on the part of the Admiralty, has promoted from the engine-room to the quarter-deck.

The treatise opens with the following clear and explicit statement of the ends fulfilled by the instrument:

1. It enables us to discover whether there are any defects in those parts of the machinery by which the steam is admitted to the piston; for instance, it indicates whether the slides are properly set, or leaky; whether the stops on the intermediate shaft are properly placed; whether the steam-ports are large enough; and, consequently, whether a different arrangement of the working part of the machinery would be advisable. In fact, in the hands of a skilful engineer, the Indicator is as the stethoscope of the physician, revealing the secret workings of the inner system, and detecting minute derangements in parts obscurely situated.

2. It discovers, at any instant of time, and under any given circumstances, when it may be desirable to apply it, what is the actual power of the engine.

A description then follows of the instrument as it is ordinarily constructed by Messrs. Maudslay and Field, illustrated by a very good set of engravings. It may be described briefly as consisting of a small hollow cylinder, which communicates with the working cylinder of the engine, and contains an easy-fitting piston, from the rod of which a pencil projects, which bears against a roll of paper divided into equal squares and wrapped round an adjacent cylinder, which is made, by means of clock-work, to revolve alternately from right to left and from left to right; that is, to have a motion exactly corresponding with that of the piston cross head. The pencil thus traces on the paper not only the entire vertical length of each stroke, but the variation of the pressure during every portion of each stroke. The following rules for reading off the various indications of the pencil may be taken as a favourable example of the sort of practical information afforded by the present treatise:

Bearing in mind that all *vertical ascending* motions are caused by an *increasing* pressure of the steam, and that the *descent* of the pencil is the consequence of the elasticity becoming diminished; and again, that as the traversing barrel revolves from left to right, the piston is descending;[1] while, on the contrary, as the pencil moves from right to left, the piston is ascending;[1] hence, we shall arrive at the following general conclusions:

1. If the motion of the pencil be vertically upwards, as at 1, the steam pressure is *increasing*, but the piston is *not moving*.

1 +

2. If the motion be downwards, as at 2, the steam pressure is *decreasing*, but the piston *not moving*.

2 +

3. If the line be placed horizontal, thus,

3 +,

the steam pressure *does not vary*, but the piston is *descending*.[1]

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* The Indicator and Dynamometer, with their Practical Applications. By Thos. J. Main, M.A., Professor R. N. Coll., Portsmouth; and Thomas Brown, Engineer R. N. 43 pp. 8vo. With Plates and Woodcuts. Woodward, Portsea; and Hebert, London. 1847.

1 This will be the case in one engine, but not necessarily so in another engine; and moreover, if the string be led in another direction the reverse will happen; but this the practical man can correct for himself according to circumstances, and substitute *ascending* for *descending*, and *vice versâ*.

4. If the line be thus,

4 +,

the steam pressure *does not vary*, but the piston is *ascending*.[1]

5. If the line run as at 5, the steam pressure is *increasing*, and the piston is *descending*.[1]

5

6. If the line run as at 6, the pressure is *decreasing*, and the piston *descending*.[1]

6

7. If the line run as at 7, the pressure is *decreasing*, and the piston *ascending*.[1]

7

8. If the line run as at 8, the pressure is *increasing*, and the piston *ascending*.[1]

8

A number of examples are then given of the application of the instrument, and of the circumstances by which the accuracy of its indications is liable to be affected, illustrated mostly by actual diagrams obtained by Mr. Brown on board the Government experimental steamer *Bee*. One rather anomalous case is mentioned, which merits citation, on account of the important conclusions which it apparently involves:

How can the Indicator be employed for ascertaining the quantity of steam an engine uses?

Fix on any convenient part of the steam-line between that point where the steam is cut off and the opening is made to the condenser. Observe, by counting the vertical spaces, what proportion the portion of the stroke, as far as this point, bears to the whole length of the stroke. Notice also the pressure of the steam at this point. Then we shall have a certain fraction of the cylinder filled at each stroke with steam of a given pressure. If now the cubic contents of the cylinder be determined, and the number of times the cylinder is filled per minute, we shall have the quantity of steam of known pressure supplied to the engine per minute. Thus, suppose that in the *Bee* $\frac{9}{10}$ of the cylinder were filled with steam of 15 lbs. pressure; then, since the number of cubic inches in the cylinder twice filled is 15079·6, the number of revolutions being 34 at the time of experiment, the whole number of inches in a minute

$= 512526·4$, $\therefore \frac{9}{10} \times 512526·4 = 461273·76$, and the number of cubic inches of atmospheric steam in an hour

$$= 461273·76 \times 60 = 27676425·60.$$

But each inch of water is supposed to form 1711 cubic inches of steam at the atmospheric pressure, and therefore the number of cubic inches of water evaporated

$$= \frac{27676425·6}{1711} = 16175;$$

and the number of gallons of water evaporated

$$= \frac{16175}{277} = 58 \text{ nearly.}$$

Now, if the theory be correct, this should be the quantity of water evaporated from the boiler, due allowance being made for condensation, &c., in the steam-pipe and passages. But this is far from being the case, for the number of gallons actually evaporated by the boiler was ascertained to be 108 gallons in the hour. We can do nothing more at present than state the discrepancy, and offer the following hypothesis to account for it. From the violence of the ebullition, the steam is in all likelihood not so dry as that on which careful experiments are made, as is frequently made manifest in boilers that "prime;" so that, even in good boilers, it is very possible for the steam to contain much more watery vapour than it would if it were not so rapidly consumed. If so, an inch of water would not under these circumstances form 1711 cubic inches of steam under the atmospheric pressure, and might perhaps form only one-half that quantity, which would be requisite to give the proper number of gallons of evaporated water. It remains to be seen by future experiments whether this be the fact; and if true, it will throw doubt on the tables of relative volumes of steam and water contained in most works on the steam-engine.

A few pages at the end of the work are devoted to the Dynamometer (hardly enough to justify the place which that instrument holds in the title,) on account of the use which has been recently made of it on board of screw vessels, to ascertain the exact amount of pressure given off by the screw-shaft, and consequently the amount of propelling force which the engine exerts.

It is as a treatise on the Indicator, however, that this work is to be chiefly regarded, and as such it is deserving of every praise. It seems to us admirably calculated not only to improve the engineers of our naval and mercantile services in the use of this instrument, but to make the employment of it more general as well on land as at sea. As no steam-engine should be without an Indi-

cator, so no Indicator should be unaccompanied by this guide to a true understanding of its properties and uses.

THE "PLUS AND MINUS PUZZLE."—AN AMICABLE ADJUSTMENT.

Sir,—I am not fond of obtruding my private history on the public, but your correspondent "Oseg's" illiberal estimate of my mathematical reputation, and his surprise at my folly, as he is pleased to term it, will, I think, justify my making you further acquainted with myself. I will, however, premise that the idea of turning my friend's argument against himself *did* occur to me at the time, but I rejected it at once as ungenerous; and as to the Cambridge equation not having "opened my eyes to the former," I can only say that I did open my eyes, and that very wide, at both of them.

In a letter to you in May last (p. 548,) I stated that it was my appointment as sub-engineer on the Glenmutchkin line that first called my attention to mathematics, and though, for my time of life, I made considerable progress, and knew, perhaps, as much of the subject as any of my brother-engineers, I must still confess to an "utter innocence" of the Differential Calculus. I am consequently unable thoroughly to appreciate "Oseg's" solution, though, as far as my lights go, it appears highly satisfactory, and may partially exonerate algebra from the blame I attached to it. The only differences with which I am acquainted—alas! but too well—are those whose only partial settlement on my part has led to my retirement from the turf.

"Quand celui qui parle n'entend rien, et celui qui écoute n'entend plus, c'est métaphysique." This maxim, which I picked up during my residence abroad, convinced me that it would be metaphysical, and consequently useless, for me and my friend (Mr. Cheetham, of the West Diddlesex Junction) to enter into the Differential Calculus; and I accordingly determined to take the advice so kindly sent me by Mr. Wilkinson.

I luckily found my friend at home, and commenced as prescribed. As soon, however, as I asserted that the equation $B\ (A-B)=0$ consisted of two independent factors, $A-2B=0$ and $B=0$, Mr. Cheetham stopped me short, and inquired how I knew that $B=0$, for it would be equally true to maintain that $B=97$, or any other number, as there was no doubt that $97 \times 0=0$, and consequently there was no reason to suppose that B had departed from its original intention of representing half-a-sovereign. I perceived that he was in the right, and that nothing was to be got from Mr. Wilkinson's advice, however kindly intended.

As a last resource—

> "Quid non mortalia pectora cogis
> Auri sacra fames?"

I turned my friend's argument against himself, and assured him that I was now convinced that $A+B$ and $A-B$ were identical, and such being the case, I should much prefer his paying me the former. This was quite an unexpected turn—

> "'Twas his own genius gave the final blow,
> And help'd to plant the wound that laid him low;
> Keen were his pangs, but keener far to feel
> He nursed the pinion which impell'd the steel."

He soon recovered himself, however, and suggested, that as we were agreed upon the facts of the case, and there only existed a difference of opinion as to which of the sums he ought to pay, a middle course would be most creditable to both parties. I was struck with the good sense displayed in this remark, and on his paying me a further sum of ten shillings I gave him a receipt for the whole amount; and promising that he should hear no more of the matter, we parted mutually satisfied.

I must now apologize for taking up so much of your space and express my gratitude for your assistance, and remain

Yours, &c.,

J. E.

Nov. 23, 1847.

MONUMENT TO DAVY.

We notice, with pleasure, a tolerably widespread movement in the mining world, for the erection of a monument to the memory of the late Sir H. Davy. As a public benefactor, he richly merits such a memorial at our hands. In the ancient world, his statue would be adorned with garlands innumerable, in testimony of the innumerable lives which, by his genius and ingenuity, had been saved to the service of the state. His mortal footsteps are radiant with a light, which will burn on for the illumination and instruction of all the classes, and all the kindreds, of civilized mankind. His wor

peaceful conquests—his that silent m—which is seen in the additions it ; to public happiness, and in the en- ıent it gives to public knowledge: edge, by which the foundations of are strengthened, and the force and ion of the external elements so sub- to the government of a human hand. as, in every sense, a man, whom the ations, in their best times, would have proud to enrol with their most re- :d citizens, and to create for them per- ıt ensigns, and garlands personal. It our purpose to bring into review, at oment, the vigour and the universality researches in chemical science; but, ıly, in the few years of his active life, l done more for the advancement and idation of its leading principles than :en done since the days when Boyle and dish were raised up as pillars of light : temple of experimental chemistry. llustrious man, moreover, was some- beyond a professional chemist. He he larger faculty, which enables its sor to trace and comprehend the gene- me of things, from the pebble which to floor our garden path up to the lightning. He saw, and dwelt upon, he pleasure known only to a mind :uted like his, the almost infinite links t golden chain which holds heaven rth together. He was speculative up lights to which reason or analogy will ı philosopher to soar; and chastened, heless, in every ascending step he y the lessons of experiment and de- ·ation. He is known to the mining .tion of these islands by his happy in- ı of the Safety Lamp—a simple, but fficient contrivance, which has econo- human life in the deep mephtic s of these kingdoms to an extent few would apprehend, and fewer still ılculate. It is to commemorate the ıdowments and beneficent life of this ıan that the erection of a monumental ı is now proposed. It is, in fact, g no flowers upon his grave, nor ing any gratuitous honours on his ty and kindred: it is not from any ıotive that the public will raise the , or that succeeding generations will ' it. It is rather a slow, an insufficient ıt of a debt we owe to a great public :tor, and that we teach our children, perpetuated example, also to scorn s and live laborious days—aiming at [uisition of a character as pure, and putation as wide, as that of the most :d by Nature, and the most fortunate cumstances.—*Mining Journal.*—Let e a monument by all means; next to Newton, no man of science of this country ever deserved one more. But do not let any error, in point of fact, be mixed up with the grounds on which his memory is cherished. The Safety Lamp was, indeed, one of the greatest triumphs of his genius; but it is an historical untruth to say that it has "economized human life." On the contrary, the loss of life from explosions of fire-damp has been much greater *since* the introduction of the Davy than *before* it. And this is reasonably enough accounted for in two ways; first, by the neglect which the use of the Davy has induced of ventilation, which is a much surer means of preventing such accidents than any mode of lighting whatever: and, second, by its having enabled coal-owners to work mines so dangerously foul, that but for the Davy they could not, and would not, have been worked at all. The people benefited by it have been the coal-owners, but the poor coal-workers not at all. So largely, indeed, are the former its debtors, that were they alone to defray the cost of the proposed monument, they would be but performing a very ordinary act of gratitude. All this, however, detracts nothing from the merit of the invention itself. Employed in subordination to the interests of humanity, it was of a nature to confer incalculable good; and it is no fault of the inventor that it has been prostituted to the purposes of a base and ruthless cupidity.—Ed. M. M.

ADCOCK'S SPRAY PUMP.—REPLY BY MR. ADCOCK TO CASSEL MORLAIS, AND OTHERS.

(Continued from page 501.)

"Cassel Morlais" (if he were at either of the public exhibitions of the spray pump—which I must be permitted to doubt) may, certainly have made—that is, entered into a book—memoranda, in the presence of several gentlemen, without one of them being cognizant of what he was writing. Of this I am quite satisfied, that not one of the gentlemen then present was made acquainted with, or gave sanction to, any memoranda so opposed to the facts before him. "Cassel Morlais" states, that the section of the pit is 240 ft.; the incoming quantity 30 cubic feet—which is equivalent to 187½ gallons per minute; and the height of the lift 20 ft. Whereas, the section of the pit, at the then water line, is 276 ft.; the incoming quantity of water per minute, 490 gallons; and the height of the lift, 54 ft. And, in addition to these, when the spray pump was first working, a quantity of water was drained from the adit level, which was 22 ft. long, and 4 ft. wide. Hence, admitting that

"Cassel Morlais" is not far wide of the truth in his assertion, that the body of water in the pit was sunk 2 ft. 6 in. in 8 minutes (for it was 2 ft. 3 in. in 7 minutes,) we shall find that, after making the above necessary corrections of his statements, the spray pump yielded an effect equal to 20-horse power, and not 4-horse power, as he has represented it to have been. It may be shown thus:

Quantity of water withdrawn from the pit,

$$\frac{276 \text{ ft.} \times 2\tfrac{1}{2} \text{ ft.} \times 6\tfrac{1}{4} \text{ galls.}}{8 \text{ minutes.}} = 547 \text{ galls.}$$

Quantity of water withdrawn from the adit,

$$\frac{22 \text{ ft.} \times 4 \text{ ft.} \times 2\tfrac{1}{2} \text{ ft.} \times 6\tfrac{1}{4} \text{ galls.}}{8 \text{ minutes.}} = 172 \text{ galls.}$$

Incoming quantity per minute........ 490 = 1209 gallons.

Making a total of 1209 gallons per minute, equal to 12,090 lbs., raised to the height of 55 ft.

$$\text{Hence, } \frac{12{,}090 \times 54 \text{ ft.}}{33{,}000} = 20 \text{ horse-power.}$$

But even these details do not give the exact relation between the power and effect; for the slits admit of being opened to a certain width only; and as at the time of the public experiments, the openings were at their utmost width, and maintained at such, the body of water flowing through them into the upcast pipe, lessened, as the height of the column of water in the pit decreased. In order, therefore, to obtain a near approximation of the effect yielded by the spray pump, the calculations ought to be based on the first observation that was taken; in which the water was sunk in the pit 20 in., or a foot and two-thirds, in 4½ minutes. The calculations will then stand thus:

$$\text{From the pit:—}\frac{276 \text{ ft.} \times 1\tfrac{2}{3} \text{ ft.} \times 6\tfrac{1}{4} \text{ galls.}}{4\tfrac{1}{2} \text{ minutes.}} = 639 \text{ galls.}$$

$$\text{From the adit:—}\frac{22 \text{ ft.} \times 4 \text{ ft.} \times 1\tfrac{2}{3} \text{ ft.} \times 61 \text{ galls.}}{4\tfrac{1}{2} \text{ minutes.}} = 204 \text{ ,,}$$

Incoming quantity, per minute .... 490 ,, = 1333 galls.

Exhibiting a total of 1333 galls., or 13,330 lbs., per minute, raised to the height of 54 ft.

$$\text{Hence, } \frac{13{,}330 \text{ lbs.} \times 54 \text{ ft.}}{33{,}000} = 22\text{-horse power.}$$

But those who were at Llanhiddel will recollect that, in addition to the above, a considerable quantity was drained from the adjoining pit, and other quantities fell back into the pit from the launder, and had to be re-raised. I will, however, allow the calculations to remain as they now are, and proceed with other parts of the inquiry.

1333 gallons of water per minute is a large quantity; and those who were present may recal to mind, that it was *quite as much as that*, by the following:—At the bottom of the receiver, in which the water, after it is raised, is collected, there is a pipe leading vertically downwards to the extent of 5 ft., to convey the water, when in a solid state, from the receiver to the launder. The bottom part of that pipe is 9½ in. diameter; and at the top, near its junction with the receiver, it expands, bell-mouthed, upwards, from 9½ in. to 11½ in.; yet the body of water was so great, that the pipe became choked, and the water in the receiver stood, *in a solid state*, 4 in. above its bell-mouth.

The vertical pipe, by a bend at the bottom, delivered the water into the launder; and it flowed thence into a zinc tub. In that tub was an orifice 12 in. diameter, through which the water was discharged into a channel, and thence, through a culvert, into the river. At the first part of the experiment, when the head of water had not subsided to any extent in the pit, that 12-inch discharging orifice was maintained constantly full, by the stream of water flowing through it—which is a convincing proof of the quantity; as it is well known to practical men that a 12-inch orifice, under a head of 1 foot above the centre of its aperture, or 6 in. above the top of it, will discharge 1440 gallons per minute. Again, a culvert 11½ in. wide, and 8½ in. deep, although with a rapid fall, was barely sufficient to carry the water away. These, therefore, are sufficiently corroborative of the fact.

I have now shown, by these investigations, that the blowing-cylinder, at Llanhiddel, has been worked to the same amount of pressure, per square inch, as I there employ, by a 26½-horse power steam-engine, and that the effect yielded by the spray pump was 22-horse power. I now state further, as an axiom,

had the same body of water been raised higher, the effect yielded would have 26½-horse power; and, had the addi- lift been 20 ft., it would have been rse power.

$$\frac{(54+11)\times 13{,}330\text{ lbs.}}{33{,}000\text{ lbs.}}=26\tfrac{1}{4}\text{-h. p.}$$

$$\frac{(54+20)\times 13{,}330\text{ lbs.}}{33{,}000\text{ lbs.}}=30\text{-h. p.}$$

d I confidently appeal to the gentlemen rere present, whether, when I removed llecting cone, the water was not forced greater height! The fact is, the 12- pipes, now at the pit, are intended for ttom of the mine, when it is sunk to lculated depth of 200 or 260 yards, ence, under certain definite laws, the will expand upwards, to reduce the ty of the effluent current. Had the been proportioned for the experiment a greater body of water would have lelivered, and the relations of power ffect have been fulfilled; and where is a pumping apparatus, under the ordi- nodes of construction, may I ask, that have yielded, power for power, so an effect? In my apparatus, also, it be considered there is, comparatively, ar and tear.

HENRY ADCOCK.

—◆—

K'S SPRAY PUMP.—STATEMENT OF EXPERIMENTS MADE AT LLANHID- COLLIERY. BY REGINALD J. BLEW- , ESQ., M.P.

ng interested in a large coal-field, at iddel, extending over nearly 1,000 acres untain land, within the mineral dis- f Monmouthshire, I, about two years half ago, ascertained, by boring, that was a vein of coal, 3 feet thick, lying that property, at a depth of about 65 ; and the presumption, from this dis- r, being, that the other veins usually below would also be in place, I ordered ine, of great power—36-inch cylinder, stroke, and three large boilers—in to meet any casualties that might occur ding to the deepest veins. I had not eard of the spray pump. The engine cessary erections connected therewith not completed until the summer of when I commenced sinking, in the manner, with a 12-inch pump, the g of which was so arranged, that it hree strokes of the engine to produce the pump. At the depth of about 25 the incoming water had so much in- d, that it could only be kept down by g the engine 30 strokes per minute— making 10 strokes of the pump—a rate of speed which I considered imprudent and unsafe, and I had, therefore, determined to have a larger pump.

At this time I heard of Mr. Adcock's invention. The engineer I had employed to make my engine, &c., at Llanhiddel, was a Mr. Wm. Vincent Wennington, since de- ceased; he was a young man, of rising emi- nence in his business—a good mathematician and practical mechanic—of a prudent, and far from a *speculative* character; and he had, moreover, great practical knowledge and experience on the subject of compressed air—its power, properties, &c., having been largely engaged, and very successful, in the making of blast-engines and cylinders. In the month of August, 1846, I requested Mr. Wennington, who lived in Staffordshire, to see the spray pump, then in experimental operation near his residence, and to give me his opinion upon it professionally, and as a friend. On the 3rd Sept., 1846, Mr. Wen- nington wrote me thus:—"I have spent considerable time this week in investigating the merits of the blast-pump apparatus, and I am satisfied of the importance of the invention. With a few alterations in the details of the application, I think it can be made *an admirable thing in mining opera- tions—equally efficient at 1 as 1,000 yards in depth.*" On the 12th Sept., 1846, Mr. Wennington said, in a letter to me—"I am more and more convinced of the importance of the invention: it will, in the first place, save half the expense of pump-trees, buckets, &c., besides which, there is no wear and tear at all. The principle is as unerring as any recognized law of nature can be, and the application of it is both simple and effective."

In consequence of Mr. Wennington's opinion, I invited Mr. Adcock to Llantar- nam, and ultimately, with Mr. Wenning- ton's full concurrence, and under his advice, I made arrangements for the application of the spray pump to my pit at Llanhiddel. After considerable delay, arising from Mr. Wennington's long illness, and subsequent untimely death, the apparatus, in its simple form, was completed. A trial was made be- fore some of the principle iron-masters and coal-owners of the district, and the princi- ple of the invention, was, as I considered, then clearly proved and admitted.

I had then to apply the invention to sink- ing. In sinking, it is, of course, necessary that the water at the bottom of the pit shall never exceed a few inches in depth. The spray pump requires for its action a certain altitude of water above the slit. The only way, therefore, in which the spray pump could be made available for sinking, was to

raise the water from the bottom of the pit by the common pump to a certain distance, and then to discharge it into a reservoir, in which the bend-pipes should be placed. This arrangement was carried out, and completely answered the purpose; but the sinkers have always been very much prejudiced against the invention; and as, in this form, it is more complicated, and attended, in so shallow a a pit, with little or no diminution of expense, I am not inclined to recommend, nor do I recommend, this adoption of the spray pump *for sinking*. With this exception, I am of opinion—as far as my humble opinion is entitled to any weight—that the spray pump, for the purposes of raising water from mines, has been, and may be, considered eminently successful. Nothing can be more simple than the apparatus required for a pit sunk to its intended depth. The following is a plain practical view of its operation:—The band-pipes communicating, in their downcast length, with the air reservoir; and, in the upcast, with an open tub of zinc, having a zinc cone suspended over the centre of the pit to collect the spray, are immersed in a sump at the bottom of the pit, having not less than a certain altitude of water.

The engine is set to work; the slit being gently and partially opened, a sort of struggle would at first seem to commence between the air and the water. In a few seconds, the water, dispersed into the most minute particles, is seen to rise, and, striking against the cone, to fall into the bottom of the receiver, from whence it flows away in a large stream—while the particles of air, emancipated, as it were, from the weight of water, rush together, and make their escape at the top of the receiver, left open for the purpose—a wider opening of the slit, and an increased action of the engine, produce such an upthrow of water in the form of gigantic drops, and such a whirlwind of air struggling for expansion, as it is not easy to conceive or describe.

Much has been said as to the great power of an engine; and it has been most untruly asserted, that nearly all of its power is necessarily used in raising water by the spray pump from a pit of 80 ft. deep. The engine, as I have before stated, was provided, *ex abundanti cantelâ*, to meet all casualties that might occur in the old and ordinary manner of sinking; and I believe it will not be denied by any experienced miner, that a surplusage of power, though, for a time, it may be attended with apparent loss, is often, in the end the truest economy. The large dimensions of the beam, cylinder, and other parts of my engine, of course, require a large supply of steam to keep it going; but a pressure of 15 or 16 lbs. to the inch on the boilers has, I am assured by my chief engineer, been found amply sufficient to keep down, by the double pump used for sinking, the incoming water—say, 500 to 600 gallons per minute—and what could be done by the full power of the engine is as yet unknown; as, when any great power has been applied, the existing pipes have proved inadequate to discharge the water raised; and when the cone, suspended over the top of the pit, has been removed, the water has been blown into the air to the height of 100 ft. and more.

What may be the limit of the powers of the spray pump, I have no means of forming an opinion; but I believe, with Mr. Wennington, that it may be made as effective at 1,000 yards as at one.

THE EMPLOYMENT OF HEAT AS A MOTIVE POWER.—NOTE ON "A. H.'S" PAPERS.

Sir,—There are several things in "A. H.'s" papers upon "The Employment of Heat as a Motive Power" which I should like to notice, but the subject is so new to me, that I shall content myself for the present by drawing his attention to one or two points only, in which I think he has erred a little. At page 404 he has the equation

$$C = nA\,(r' - r) + W$$

where (n) is the number of *chemical* atoms in the substance. Now if we consider the atom not as the unit of *chemical* power, but of *weight* or of *volume*, we shall by using the same kind of notation obtain

$$C_1 = n_1 A_1\,(r_1 - r_0) + W,$$

or $$C_2 = n_2 A_2\,(\rho_1 - \rho) + W;$$

and in each of these three cases it is, *à priori*, as probable that

$$A_1\,(r_1 - r_0) = B_1\,(s_1 - s_0),$$

or that $A_2\,(\rho_1 - \rho) = B_2\,(\sigma_1 - \sigma)$,

as that $A\,(r' - r) = B\,(s' - s)$.

In fact, it seems to me to be a *petitio principii* to assume any one of them in preference to another.

It appears, indeed, "highly probable" when one substance is as much charged with heat as another, that the increment of linear distance between any two atoms of the one should be to that increment in the other, in the same ratio as that of their respective average resistances to separation; and it then follows clearly enough, even without the help of a visible formula, that the whole heat applied to each substance depends upon the number of atoms in each;—but there

reason why the atoms should be red by their equality of chemical iny more than by their equality of t or equality of volume, and there- :fore experiment we have as much to say, that the specific heats of weights of the two substances are ely as their atomic weights, are or are inversely as their specific es. It is experiment alone which us that the first case is the true

: other point I wish to notice is "A. H." does not allow for the icy of the atoms to separate in the f gases as he does for their resist- to separation in the case of solids iids. Should not the equations at t be

$$P.h - mA(r'-r)w + NR(p'-p),$$

$$= Pk - nB(s'-s)w' + NR(p'-p),$$

(w) and (w') are the weights of volumes of the two gases, and are ore as their specific gravities?—

Now, since by experiment $h = k$, it follows that C and C' are not as "A. H." asserts, *equal;* but if we assume here, as before, that

$$A(r'-r) = B(s'-s),$$

then we obtain as the result that the specific heats of equal volumes of gases vary as

$$\text{A constant} - \frac{\text{Specific gravity of gas}}{\text{Atomic weight of do.}}$$

I have not at present at hand any table of the specific heats of gases other than an old one of Messrs. Delaroche and Berard, and they give for the specific heats of equal volumes the following:

Air	1.0000
Hydrogen	0.9033
Carbonic Acid..........	1.2583
Oxygen	0.9765
Azote	1.0000
Oxide of Azote	1.3503
Olefiant Gas...........	1.5530
Carbonic Oxide	1.0340

Should not also the equation page, 450, be

$$\frac{\text{Specific heat (pressure constant)}}{\text{Specific heat (volume constant)}} = 1 + \frac{P.h. - mA(r'-r)}{NR(p'-p)}$$

the same notation as in the pre- examples?

ave a shrewd suspicion that I may the case of the blind attempting to the clear-sighted, but still I thought correspondent limped a little—a thing very unusual with him—and so, following his invitation, I throw out the above hints to help us on the road.

I am, Sir, yours, &c.,

x^2.

INQUIRIES AND ANSWERS TO INQUIRIES.

mutation Lock. — Sir,—Many years invented what I called a "Permuta- ock," and after various attempts to a patent for it, I ultimately sent it Society of Arts, from which I received :r medal. Since that time I have in- l some very important improvements h lock and key; which improvements : the lock utterly impregnable to any nstrument. I cannot at present enter :r into the merits of the lock; but if f your readers, in whom confidence ie placed, should be desirous of pro- g my views, and to advance the means :uring the invention, a model will in me be forwarded to your office. I am, ours, &c., ANGUS MACKINNON, 6, ital-street, Gorbals, Glasgow.

inters' Brushes.—"Why do we never ly dark hairs in painters' brushes?"— .IST. Because white, or light-coloured are invariably of a much finer texture.

rostation.—The height to which Gay c ascended was 23,000 ft. We do not e that this has been ever exceeded.

n - blowers. — "A Founder and Ten Years' Subscriber" is referred to our Journal, No. 1242, where the subject is very fully treated. Good steel is preferable to gun-metal for the bearings.

Babbet's Anti-friction Metal.—The patent was taken out in the name of Mr. Newton on behalf of Babbet, who is a foreigner. The patent is dated May 15, 1843. The metal is composed of 50 parts of tin, 5 of antimony, and 1 of copper.

Spanners.—L. S. (Arundell) will find that he has been anticipated in his plan of a spanner by Mr. Fenn, of Newgate-street. The only difference is, that in Mr. Fenn's the screw is placed between two protecting cheeks instead of at one side.—See *Mech. Mag.* No. 1233.

"*Has a Rifle-ball but one Motion?*—Does it not both move forward and revolve in its course round its axis?"—ONE WHO HAS STUDIED UNDER WEISBACH AND ADMIRES HIM. We cannot better answer this question than by putting another in return, "Does a person in moving round a geometrical staircase do more than move in one spiral path?"

CONTENTS OF THIS NUMBER.

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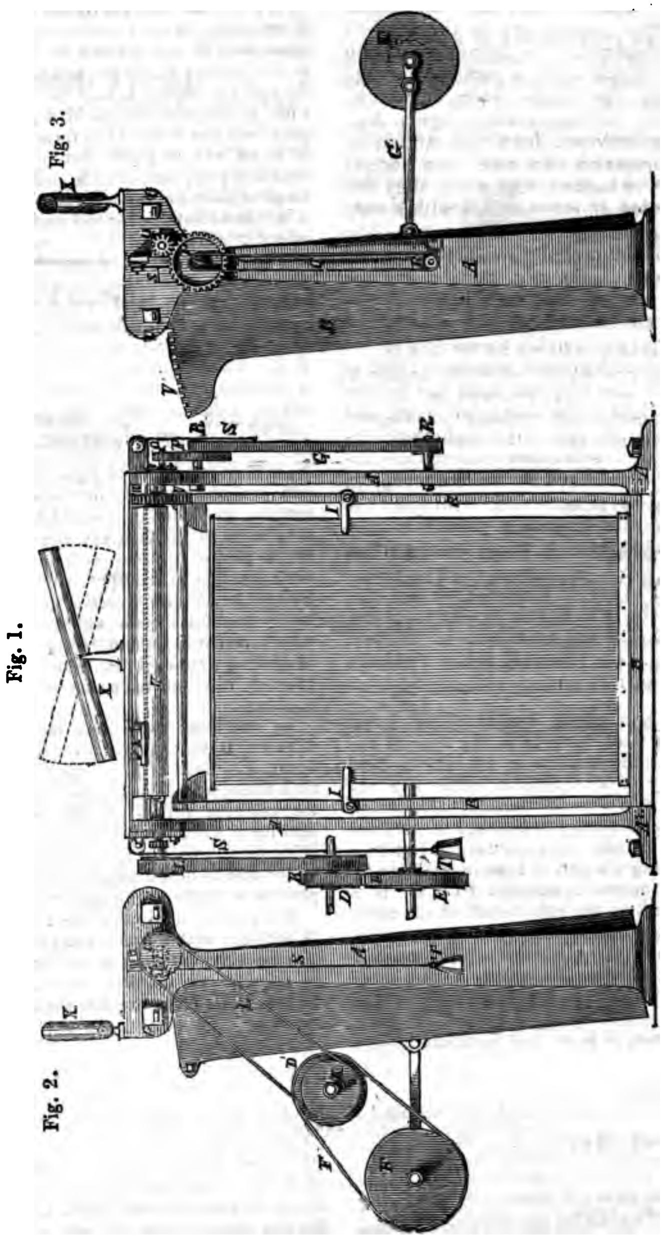

Fig. 3.

Fig. 1.

Fig. 2.

NOTICES TO CORRESPONDENT.

Mr. Huntler will please send for a pack dressed to him.

J. P. E.—Mr. G. Johnson—Mr. J. Mu M. M. F.—W. E.—Mr. Hopkinson—intend early insertion.

Communications received from J. W.—S. B —R. Green—P. P. Q.—Geometricus—A Mech Engineer.

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Mechanics' Magazine,

USEUM, REGISTER, JOURNAL, AND GAZETTE.

o. 1269.] SATURDAY, DECEMBER 4. [Price 3*d.*, Stamped, 4*d.*

Edited by J. C. Robertson, 166 Fleet-street.

LAW'S PATENT IMPROVEMENTS IN YARNS AND YARN-SPINNING MACHINERY.

Fig. 2.

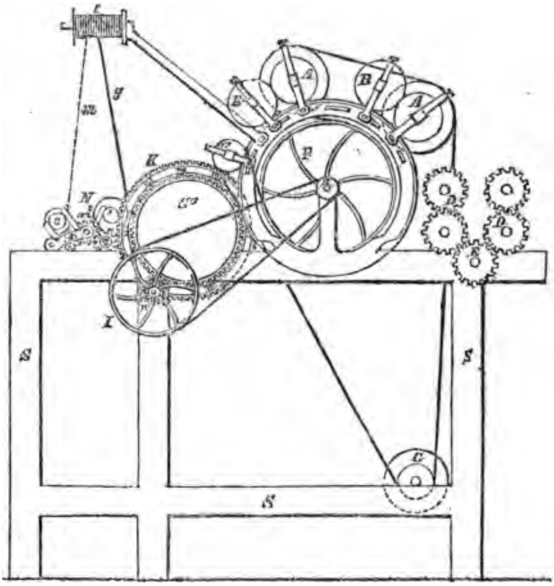
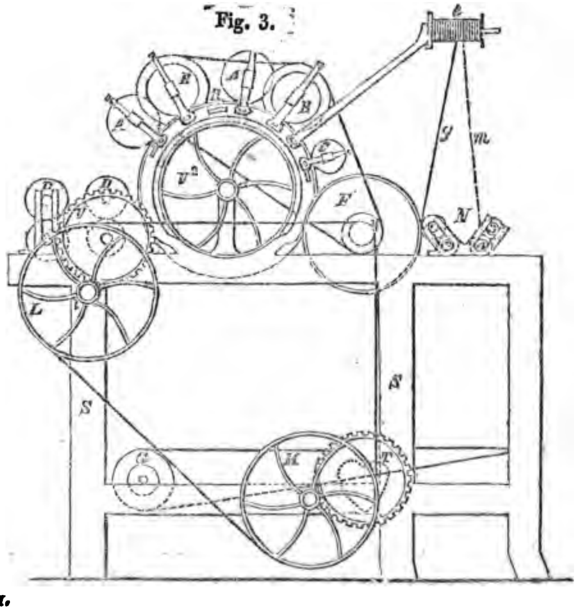


Fig. 3.



The nature of Mr. Law's improvements in yarns consists in manufacturing them of two or more different fibrous materials, such, for example, as flax and wool, or flax and cotton, or flax and silk, or cotton and wool, or cotton and silk, or flax, cotton, and wool, or of two or more different layers of fibrous materials, one, or both, or all of which, may consist of a single material, or a mixture of materials—as, for example, a roving of flax may be combined with a mixture of sheep's wool and cotton wool; and in so combining them that each of the materials, or layers of materials, shall envelope or be enveloped by another of the said materials, or layers of materials (instead of being intermixed one with another, in the manner of ordinary mixed yarns,) and so also that the material which is of the greatest tenacity, or cheapest, shall form the innermost core of the yarn, and the material which is of the most fleecy and downy or costly quality, shall form an exterior coating or covering, and be the only part of the yarn visible.

The mode of manufacturing these compound yarns is thus described:

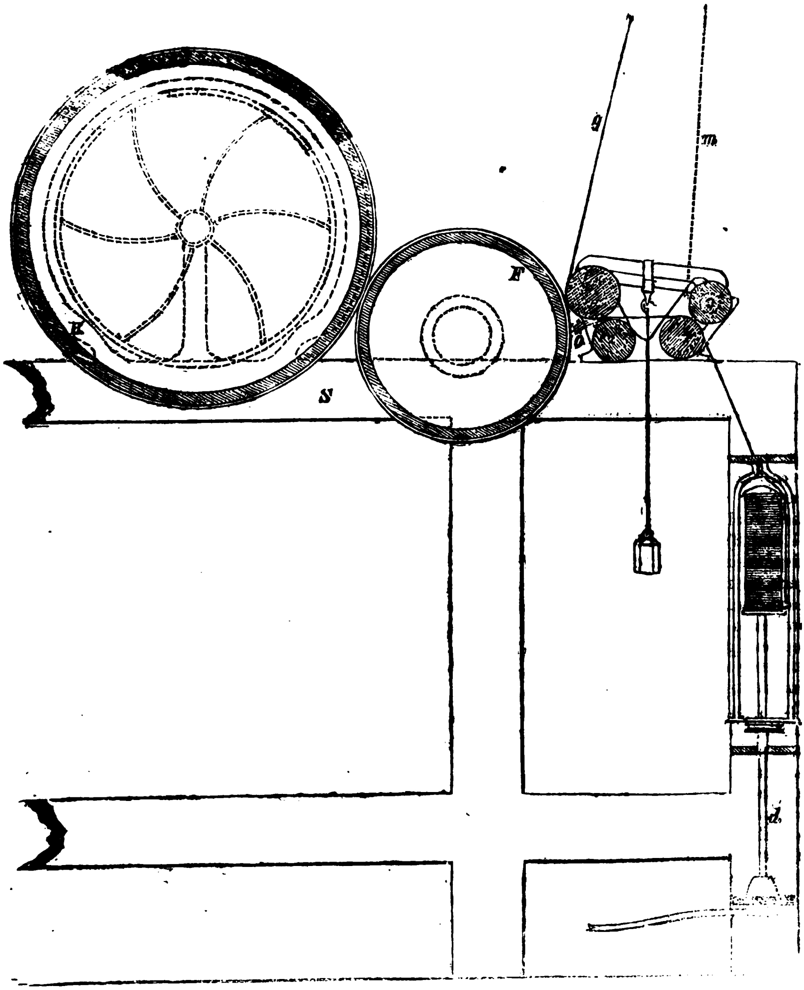
Supposing the yarn is to be a compound of cotton and wool, I take cotton which has been already spun into yarn, or roving, and envelope it with the wool by means of a machine, (such as represented in the accompanying engravings,) which consists of an adaptation of the ordinary carding-machine, called a finisher, or condenser, to the purposes of the present invention, with some few additions. Fig. 1, is a front view of this machine. Fig. 2, a right-hand end elevation of it. Fig 3, a left-hand elevation; and, fig. 4, an end elevation of the fore-part of the machine, on an enlarged scale. SS, is the framework of the machine; H, is the main cylinder, which is 14 in. in diameter, exclusive of the filletting, which is about three-eighths of an inch deep; DD, are the feed-rolls, having gear-wheels of 3¼in. in diameter; E, stud-gear, which may be dispensed with when only one pair of feed-rolls is used. AA, are the stripping cylinders, the pulleys of which are 6 in. in diameter; BB, the working or cleaning cylinders, having pulleys also 6 in. in diameter; C, is the fancy cylinder, with pulley of 2¾in. in diameter; F, is the doffer, which is 8¾in. in diameter, and has rows of filleting corresponding with the number of spindles employed in connection therewith; N, 1, 2, 3, 4, represent two pairs of delivery-rolls, which are formed of i covered with leather; the roll, 1, is 2 i diameter, and the others of 1¼in. in dia ter, and the rolls, 2, and 4, are fluted is a 12 in. pulley, with a pinion, *l*, o axis, of 1¼in. in diameter, and 22 t which takes into and drives an 8 in. w V, of 128 teeth, which gives motion t feed-rolls, DD; P, is a 12 in. pulley o main-shaft, by which the stripping and cylinders, and cylinder, G, are driven. working, or cleaning cylinders are d from a wheel, *y*, of 3 in. diameter o doffer shaft, which again derives its m from an 8 in. wheel, S^2, of 128 teeth, is worked by a pinion, *n*, of 22 teeth, o axis of an 8 in. pulley, I, which is w from a pulley, R, of 2 in., on the end main-shaft; G, is a wooden cylinder, th which motion is given by cords, as t to the spindles, *d*, *d*, *d*; M is a 12 in. ley which regulates the ordinary h motion, T, for raising and lowerin spindles; K, is a wheel of 11¼in. dian and 225 teeth, which drives the delive roll, 2, through the medium of a pini 1¼in. diameter and 23 teeth.

The delivering-roll, 1, is made to re in an opposite direction to the doff by the friction against it of the under 2, so that after the wool from the has been once introduced between the 1 and 2, these rolls perform the offic comb in regard to the doffer strippin the wool from it in a thin and very filament, which after passing betwee two rolls, 1 and 2, goes between the 3 and 4, to which last pair motion is from the roll, 2, by the intervening pi m^2. As the filament of wool enters be the rolls, 1 and 2, it comes into co with the cotton yarn, or roving, *g*, c from a bobbin, *e*, which is mounted on ings immediately overhead, and the materials are carried forward togethe tween the rolls, 3 and 4, which ma made to revolve at a greater speed 1 and 2, in order that they may draw press together the two materials. between the rollers 3 and 4, the mat thus partially united descend into the of a dead spindle, *d*, of the ordinary well-known construction, by the actio which the filament of wool is twisted r the cotton yarn or roving, and made to velope it closely and firmly, and an tional twist is given at the same time to cotton yarn or roving, so that the pro is a yarn having all the appearanc woollen yarn, but of much greater stre than any yarn made wholely of wool. V

the pulley for receiving motion from the prime mover.

In the engraving, (fig. 1,) the spindles, *d d*, are represented as being placed directly under the delivering rolls, but since the construction of the machine from which the original drawing was made, it has been found in practice that if the materials are passed to the spindles in an oblique direction, say at an angle of 30°, as indicated by the dotted lines in the figure, yarn of a much better quality is produced. In order to effect this improvement, therefore, the spindles should be placed sufficiently to the left of the delivering rolls to produce the said angle of inclination.

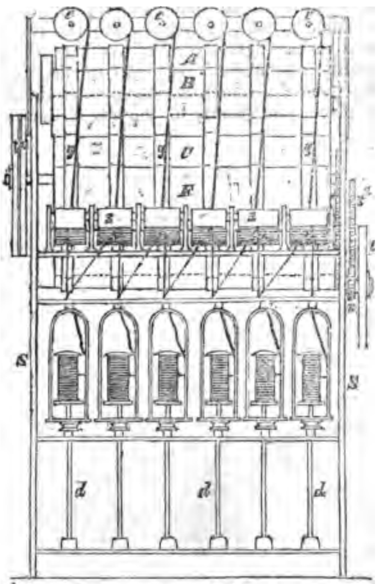
Fig. 4.



Should the preponderance of weight of the upper roll, 1, over the roll, 2, beneath, not produce a sufficient degree of friction between them to enable the former to strip the wool from the doffer, a weight may be suspended from the former to effect the desired end.

The cotton yarn or roving, instead of being brought from the bobbin, *e*, between both the sets of rolls, 1 and 2, and 3 and 4,

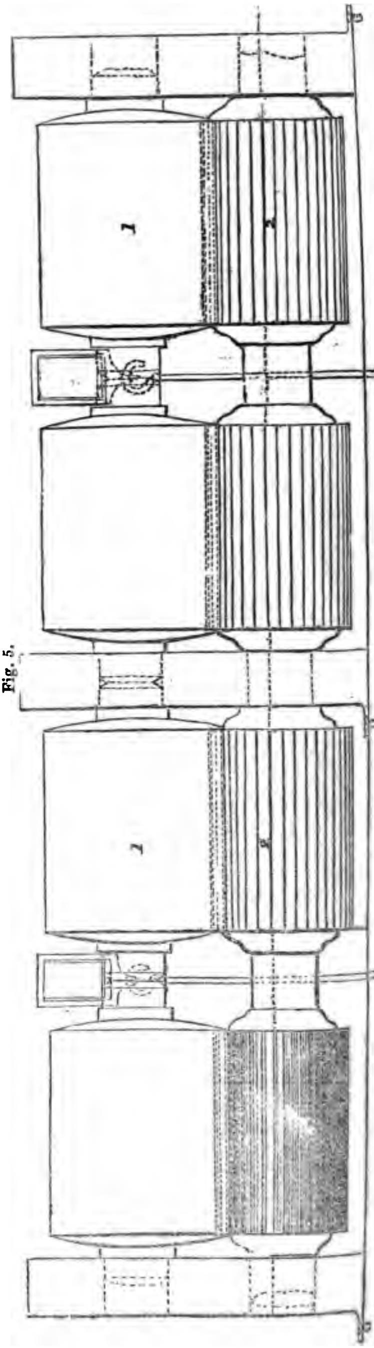
Fig. 1.



may be carried directly between the rolls, 3 and 4, as indicated by the dotted line, *m*, in fig. 4, and there first brought into contact with the filament of wool, *o*. Or the cotton yarn or roving may be passed along with the wool between the first set of rollers (1 and 2) only, and the others (3 and 4) be dispensed with; but I prefer that the cotton yarn, or roving, as well as the wool which is to envelope it should be passed through both sets of rolls and subjected the the drawing and pressing process before mentioned, as being effected by the greater speed of the one set of rolls as compared with the other. The top roll, 3, may have a lateral sliding motion as well as a rotary motion, given to it, when it will act in the same way as the ordinary list condenser, and deliver the materials to the dead spindle in a much more compact state, than when all the rolls have merely a rotary motion given to them. The upper rolls, 1 and 3, are made in pairs (as shown in fig. 5, which is an elevation of the rolls 1 and 2), in order that they may be raised more readily out of their bearings when required.

In the machine represented in the engravings, a single doffer only is used with separate rows of filletting on all the cylinders; but it will be obvious that two doffers may be employed if deemed expedient, in which case however all the other iron cylinders (exclusive of the doffer-cylinders) must have continous sheets of card clothing.

Fig. 5.



a the description which has been thus f the manner of manufacturing com- yarns of cotton and wool, the mode ufacturing such yarns of any other ls, two or more, and the modifica- f any) necessary for the purpose will ily deduced by any workman of ordi- ill and intelligence.

RAILWAY TRAIN SIGNALS.

—I rejoice to find that the public t has been at last awakened to the ity of having a means of commu- n between passengers, guards, and -drivers upon railways, and I hope ou will kindly assign to me a brief n your valuable journal to make remarks respecting the two most nent plans now before the public; y, that of accomplishing the object ns of galvanism, and that of effect- by the means of FLAGS and LAMPS. month of August, 1845, I went siderable expense in having a mo- in, consisting of six carriages, fur- with a means of communication tricity; and using the safety-chains ntermediate wires as my circuit sing of the safety-chains is the feature in Messrs. Brett and Lit- Mr. Allen's and a host of other ions,) I caused the alarm to ring ial to exhibit signals, and the ion of percussion caps as signals ger, &c. I then thought that the problem was actually and fairly , and, of course, in my youth- bition communicated my discovery Editor of an influential journal, ve me to understand in his "Notices rrespondents," on the 15th or of August, 1845 that my plan *manifestly impracticable.*" But weeks ago, when Messrs. Brett ittle followed my steps on the ton line, the same journal pro- to the world that the inventors t last solved the "great pro- ' I was, soon after my above- oned adventure, informed that the ation of electricity to the pur- as a patent right, and my railway as forthwith detached and the tiny ges were (except one which I have s a relic,) distributed amongst some juvenile friends, who no doubt satisfied with the result of my mis- ture. The above facts I am ready to prove, if any one should feel annoyed by them.

Again; I find that Mr. McConnell, of the Great Northern Railway, has submitted a plan of communicating between the guards and engine-drivers to the Railway Commissioners, who have approved of it. Now, Sir, I wrote to the said Commissioners, on the 25th of June last, urging the adoption of flags and lights as the means of effecting the purpose, and that the guard in the foremost part of the train should keep a continual look-out, and that he was to call the attention of the driver with a powerful whistle, &c. The same description is applicable to Mr. McConnell's plan,—which, however, has had the *approval* of the Commissioners; but in reply to my communication, they say, "*that they (the Commissioners) have no power to compel the adoption of anything of the kind upon any railway, and that an application upon your part to some railway company is more likely to answer the end you have in view.*" I wrote, there and then, to the Chairman of a railway company, but I confess that I did not expect a reply; and in that I have not been disappointed: "Blessed is he that expecteth nothing, for he shall not be disappointed." Now, Sir, I do not wish to monopolise all the merit in connection with the above subject, but I hope that the public will grant that I have contributed to some extent through the medium of the press to keep the GREAT SIGNAL LEAGUE ALIVE.

Yours, &c,
OWEN ROWLAND.

11, Heathcote-street, Mecklenburgh-square.

THE EMPLOYMENT OF HEAT AS A MOTIVE POWER.—REPLY BY A. H. TO "x^2."

Sir,—I have read the observations of your able correspondent with care; but I am unable to see the drift of his first remark, or what he intends to be inferred from the new equations he has written down. "There is no reason why the atoms should be measured by their equality of chemical force, any more than by their equality of weight or equality of volume." It would be fancied from this that I had "measured atoms by their equality of chemical force;" whereas I have not measured, or had occasion to "measure" atoms in

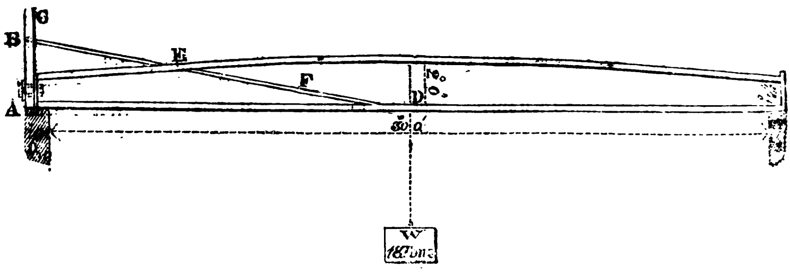
any way. In the equations of my paper, (n) stands for the *number* of atoms in the substance, and (A) for the mutual *pressure* between each pair of its particles. I am quite at a loss therefore to conceive your correspondent's meaning. The *reasons* (founded on purely mechanical grounds, and without any reference whatever to any theoretical views of the nature of heat) for assuming $A(r'-r)=B(s'-s)$ were given at some length in the last paper, to which I can hardly think that "x^2" has referred.

With regard to the second observation, viz., that "I have not allowed for the tendency of the atoms to separate in the case of gases"—and which "x^2" proposes to correct by introducing the term $mA(r'-r)w$, the answer is that this tendency is already taken into account and included in Ph. The results of Delaroche and Berard are considered by recent authorities to be inaccurate. There were several sources of error in their mode of experimenting which have been avoided in more recent researches, and the law at present accepted is as I have stated, viz., that the *simple* gases have the same specific heat under constant pressure. "M. M. de la Rive et Marcet ont cependant confirmé par leurs experiénces les resultats que Dulong avait dejà établis par la méthode que nous indiquons ci-après, savoir: que les gaz simplés ont la même capacité pour la chaleur, mais qu'il en est autrement des gaz composés." (*Pouillet Eléments de Physique*, tome ii., p. 499. Edition of 1844.)

I am, Sir, yours, &c.,

A. H.

GIRDERS AND TENSILE RODS.



Sir,—The *Builder* of to-day records a series of experiments conducted by Mr. Cubitt, of Thames-bank, to ascertain "the utility of the tensile rods sometimes applied to girders."

The clear and intelligible manner in which these experiments are described, render them particularly valuable to practical men, and I am induced to lay an abstract of them before your readers, from the fact that the result obtained prove the correctness of my reasoning on this subject, *Mech. Mag.*, *No.* 1260, p. 334. My remarks at the time caused some discussion, from the fact of their being new. And though convinced from practical observation of their truth, I had no corroborative testimony to offer.

It is, therefore, with pleasure I extract the following from the *Builder*, which after detailing some preliminary *experiments*, proceeds thus:

The above figure is an elevation of a large cast-iron girder or beam, at the end of which is shown a piece of wood, AC, securely fixed. EF, is a stout rod (representing the position of the tensile bar,) one end turning on a centre, B, and the other end resting on a block, D, fastened to the bottom flange of the girder, at equal distance from the bearings."

"The object of this experiment was to show, on applying the weight, W, how much the distance, BD, increased, or, in other words, to what extent a tension bar, fixed at the points, BD, would be stretched."

"The variation in the distance, BD, was taken by a vernier, one scale of which was affixed to the block, D, the other to the rod, EF." "The height of the point, B, above A, (or the bottom of the beam,) was varied in the experiment."

"The weight, or load, was applied by means of hydraulic pressure, and the deflection with 18 tons was 6-10ths of an inch."

"When the height of the point, B, above

1ft. 5½ in., the distance, BD, increased
."

'hen the height of the point, B, above
ıs 2 ft., the distance, BD, increased
n."

'hen the height of the point, B, above
s 3 ft., the distance, BD, increased
n."

similar experiment was made with a
on beam of different dimensions; the
ılars and details are as follow:

ength of bearings, 24 ft. 10 in.
'epth of beam in middle, 1ft. 4¼ in.
'itto, at ends, 7½ in."

he weight applied to the middle was
ıs, the deflection 7-10ths of an inch."

Vhen the height of the point, B, above
ıs ½ in., the distance, BD, increased
in."

Vhen the height of the point, B, above
ıs 10 in., the distance, BD, increased
ı."

Vhen the height of the point, B, above
s 1 ft. 8 in., the distance, BD, *decreased*
in."

Vhen the height of the point, B, above
s 2 ft. 6 in., the distance, BD, *decreased*
ı."

my remarks, (pp. 333, 334,) before
ed to, I said,

Vith regard to the bars AE and BE, I
n a previous letter shown that they
ot so much strained if fixed to the
at A and B, as the horizontal bar EF;
st there should be any doubt on this
draw aAP (fig. 3) $mnoR$, Eps normals
neutral line at the points a, n, and p,
om E draw Em parallel to np. Now,
moment let us suppose n to be a solid
ıent in the neutral axis, and the bar
be divided at the point which coin-
with it, and let the upper segment, An,
ed at A and n, and the beam deflected
traneous pressure till it assumes the
above represented; then because an
natural length of fibre, and Ao is a
lel fibre, but by reason of the pressure
ed in length, it follows that any line
g the point, An, will be proportionably
ed, and therefore compressed, and be-
the line, Em, is longer than the line,
neasured on the neutral axis, any line
g the fixed points, n and E, will be ex-
d."

Hence, taking the whole bar, AE, the
extension will be equal to the difference
een the extension and compression of
egments considered separately."

ıe intelligent reader will at once
eive that if the attached at any point,
ove A, that the length of compression
e increased, and that if the segment, An, when applied at N exceed the segment, nE, then the bar will be compressed instead of excited tensionally, and consequently the bar, AE, or as it would then be the bar, NE, would be reduced in length; which is corroborated by the experiments of Mr. Cubitt, above quoted.

The "Statement of experiments," recorded in your last Number, made on the relative strength of cast-iron chilled and unchilled at Crane-foundry, on July 21, and August 23, 1847, are fraught with practical results of the utmost importance. For though it was always known "that in castings of any variety of sections all parts cannot cool together, and therefore cannot contract alike;" "that those parts which become cold first have necessarily to resist the contraction of other parts whilst cooling; which in some cases, where the difference of section of metal is very great, even passes the limits of tenacity, the casting when taken from the sand being found ruptured," and that "in all cases of unequal cooling this must have been the effect of reducing the limits of elasticity, and must therefore weaken the girder and lessen its power to resist extraneous pressures" (*Current vol.*, p. 406.) Yet it was never I believe imagined that by merely annealing the cast bar its power would be increased to such an extraordinary extent. I hope Mr. Bowman's experiments will lead to a more extensive inquiry in this direction, which in the end may redeem cast iron from the bad reputation which as a material of construction it at present bears.

I am, Sir, yours, &c.,

W. Dredge.

London, 10, Norfolk-street, Strand,

TELEGRAPH ORGANS.

Sir,—In looking at Professor Wheatstone's Sound Telegraph, in which instead of two needles he makes use of two bells, I could not but think that the system might be applied for musical purposes as well as for signals. Evidently if a sufficient number of wires were used a set of chimes might be as easily rung as two bells,—indeed the chimes in York Minster, if there are any, might be rung from London as well as York. Where bells are placed in a high tower, as some

of the *carillons* or chimes in Flanders, they might by telegraph or electric wires be played with much more convenience from the bottom of the tower.

By a proper application of wires, two organs or two Apollonicons might be played at any distance apart by one performer; thus realizing by the electric telegraph what I believe Professor Wheatstone contemplates in the acoustic telegraph, conveying musical sounds and compositions. It is quite practicable to realize with musical instruments what has been already done with clocks, and we may have electrical organs in our churches as well as electrical clocks in our houses, and worked almost as cheaply. These are trifles; but I shall have your excuse for mentioning them, because what is an idle thought with one man sometimes puts in activity the practical application of another.

I am, Sir, your obedient servant,

HYDE CLARK.

42, Basinghall-street, Nov. 25, 1847.

ON A SIMPLE INVESTIGATION OF THE EXPONENTIAL THEOREM. BY PROFESSOR YOUNG, BELFAST.

The ordinary methods of investigating the Exponential Theorem, as given in books on algebra, are usually felt by the student to be a little perplexing. In my own experience I have found it to be advantageous, for the purposes of instruction, to replace those methods by the process which follows; and which some of the readers of the *Mechanics' Magazine* may perhaps think not unworthy of preservation among other mathematical scraps of a like character.

By the Binomial Theorem,

$$(1+a)^m = 1 + ma + \frac{m(m-1)}{2}a^2 + \frac{m(m-1)(m-2)}{2.3}a^3 + \&c.,$$

$$\therefore \quad \frac{(1+a)^m - 1}{m} = a + \frac{m-1}{2}a^2 + \frac{(m-1)(m-2)}{2.3}a^3 + \&c.$$

In this dentity put for m its extreme value, $m=0$; and we have

$$\frac{(1+a)^0 - 1}{0} = a - \tfrac{1}{2}a^2 + \tfrac{1}{3}a^3 - \tfrac{1}{4}a^4 + \&c.$$

Or, putting $a-1$ instead of a, and the symbol $\frac{1}{\infty}$ for 0,

$$\infty\,(a^{\frac{1}{\infty}} - 1) = (a-1) - \tfrac{1}{2}(a-1)^2 + \tfrac{1}{3}(a-1)^3 - \tfrac{1}{4}(a-1)^4 + \&c.$$

Call this series A: then

$$\infty\,(a^{\frac{1}{\infty}} - 1) = \mathrm{A} \ \therefore\ a^{\frac{1}{\infty}} = 1 + \frac{\mathrm{A}}{\infty} \ \therefore a^x = \left(1 + \frac{\mathrm{A}}{\infty}\right)^{\infty x} =$$

$$1 + \infty x\frac{\mathrm{A}}{\infty} + \frac{\infty x(\infty x - 1)}{2}\left(\frac{\mathrm{A}}{\infty}\right)^2 + \frac{\infty x(\infty x - 1)(\infty x - 2)}{2.3}\left(\frac{\mathrm{A}}{\infty}\right)^3 + \&c.,$$

that is

$$a^x = 1 + \mathrm{A}x + \frac{\mathrm{A}^2x^2}{2} + \frac{\mathrm{A}^3x^3}{2.3} + \frac{\mathrm{A}^4x^4}{2.3.4} + \&c.$$

which is the theorem in question.

I take this opportunity of expressing my thanks to your valuable correspondent and my far too partial friend, Mr. Cockle, for his correction of an oversight at page 132 of my book on Algebra:* his criticism is perfectly just, and his mode of treating the subject referred to entirely satisfactory.

Belfast, November 27, 1847.

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* *Mechanics' Magazine*, ante page 331.

ON THE REDUCTION OF A FUNCTION OF THE SECOND DEGREE AND OF THREE VARIABLES. BY JAMES COCKLE, ESQ., M.A., BARRISTER-AT-LAW.

Let

$$cxy + dxz + fx + eyz + gy + bz^2 + hz + i, \text{ or } [\mathrm{f}],$$

be the function; the following will serve as a practical

PROCESS OF REDUCTION.

xy	x	y	1
c	$dz+f$	$ez+g$	bz^2+hz+i
	$\cdot$		$\cdot$
	$[ez+g]$		c
	edz^2+efz		
	$gdz+gf$		
$(-)$	$\alpha z^2+\beta z+\gamma$		
	$\delta z^2+\varepsilon z+\zeta$		
	$\eta z^2+\theta z+\iota \quad [=\phi(z)]$		

We proceed thus:

Having placed in the columns headed xy, x, y, 1, the respective coefficients of those quantities in [f] we multiply the middle coefficients together and subtract their product from that of the two extreme ones.

For convenience the product of the extreme is written under that of the mean terms and so constitutes the seventh line of the process. That the sixth is to be subtracted from the seventh line is indicated by the $(-)$ before the former.

The inference to be drawn from what precedes is, that [f] can be put under the form

$$\frac{1}{c}\left\{(cx+ez+g)(cy+dz+f)+\phi(z)\right\}$$

When in my last paper (*supra*, page 504,) we have $p=0$ and $a=0$, then [F] becomes [f]; and when we also have $b=0$, the absolute necessity for the process here given is obvious.

At pages 61—62 of the *Lady's and Gentleman's Diary* for 1848, just published, the learned Editor of that work has answered a question which I had proposed in the preceding Number. As most probably the *Diary* is easily accessible to the greater part of the mathematical readers of this Magazine, I shall content myself with referring them to that source for further information on the subject of the following observations.

In the remarkably clear and simple paper of Mr. Woolhouse let $\mathrm{A}=1$, and for

$$b,\ c,\ f,\ e,\ d,\ g,\ h,\ i,\ k,$$

substitute $\quad a,\ b,\ c,\ d,\ e,\ f,\ g,\ h,\ i,$

respectively; also, in [F] (*sup.* page 504), let $p=1$; then will u and [F] become identical.

Now Mr. Woolhouse's investigations applied to [F] will, with the above modifications and assumptions, give (see *Diary* for 1848, page 62,)

$$a=\mathrm{P}p\ldots\ldots(1), \qquad c=\mathrm{P}+p\ldots\ldots(4),$$
$$e=\mathrm{P}q+\mathrm{Q}p\ldots(2), \qquad f=\mathrm{R}+r\ldots\ldots(5),$$
$$d=\mathrm{Q}+q\ldots\ldots(3), \qquad g=\mathrm{R}p+\mathrm{P}r\ldots(6),$$

and also

$$\phi(z)=(b-\mathrm{Q}q)z^2+(h-\mathrm{Q}r-\mathrm{R}q)z+i-\mathrm{R}r\ldots(7).$$

2, Church-yard-court, Temple,
November 19, 1847.

STEAM-BOILER EXPLOSIONS.

Sir,—As low-pressure steam-boiler explosions still continue to take place in Leeds, Halifax, Bolton, and other places in the manufacturing districts, and as the

persons to whose care the boilers are entrusted, seem generally to be but little acquainted with the causes of such disasters, I beg to offer a few remarks on the subject, in the hope that they may be of some use in dispelling the prevailing ignorance in respect to it.

The verdict of the jury on the late steam-boiler explosion at Leeds, states that the explosion of the boiler arose from a deficient supply of water; and no doubt there is every reason to conclude, that there was little or no water in the boiler when the engine stopped at the dinner-hour. During the dinner-hour the fire was acting on the boiler's bottom, and would likely enough cause it to become red hot. When a boiler bottom is in this state, the least quantity of water which comes in contact with it will generate steam so quickly as to burst any boiler, however strong, if there be not an opening sufficiently large to allow the steam to escape as fast as it is generated.

The American Government instituted a series of experiments on the subject of boiler explosions,—which experiments are reported in the *Mech. Mag.*, No. 790, vol. xxix. In the course of those experiments, it was found that when a boiler bottom was in a state of dull red heat, and water was forced in jets into the boiler, the steam was generated so quickly as to raise the pressure of steam from 1 lb. to 180 lbs. to the square inch in the short space of one minute! The safety-valves and feed-pipes of steam-engines are rarely, if ever, large enough to allow such a quantity of steam to escape as fast as it is made or generated; and when such is the case, the inevitable consequence is an explosion. The best way of making an opening sufficiently large to allow the steam to escape as quick as it is generated, is to have a pipe 12 or 15 ins. diameter, and 22 ft. long, open at both ends, and placed upright in the boiler, with the lower end so low as to be within 10 or 14 ins. of the bottom. This pipe would be in principle the same as the common feed-pipe, or as Mr. Collier's pipe for extinguishing the fire when the steam gets too high,—described in No. 695, vol. xxvi., of your Magazine. A pipe of the above description, and so placed, would let any quantity of steam or water escape as fast as the steam was generated, and would never allow the pressure of steam to get beyond 10 lbs. to the square inch, which is a pressure as high as any waggon-shaped boiler should have. Wherever such a pipe was employed the owner might rest satisfied that no explosion could take place either from want of water or from sticking of the safety-valves, through neglect or any other cause. I am, yours, &c.,

WILLIAM HOPKINSON,
Engineer.

Chapel-hill, Huddersfield, October 18, 1847.

FRANKLIN'S OIL AND WATER EXPERIMENT.

Sir,—I beg to trouble you with a word or two in attempted explanation of the phenomena exhibited in Franklin's experiments, to which your correspondent "A. H." makes allusion, but without offering any elucidation of it, though he does adduce it in exemplification of certain doctrines more or less clear, on which it seems to have little or no bearing. First, however, let us note what the conditions and phenomena of the experiment are:

1st, There is a containing vessel in motion. 2nd, Two inelastic media—water and oil. 3rd, The elastic atmosphere in contact with the surface of the oil. The phenomena to be accounted for are these: 1st, When the surface of the water is exposed to the air it remains at rest. 2nd, When covered with oil, it rises and falls with considerable undulation; and we may readily suppose that if the oil were covered with another inelastic fluid medium that would undulate in like manner.

Remark 1st. Motion is impeded by an inelastic fluid medium only by the friction of particles; the resistance of its gravity being equal and contrary, is therefore self-compensating.

Remark 2nd. Motion is impeded by an elastic fluid medium, because of the opposing action of its elasticity, which, by distributing the motive impulse through its mass, infinitely divides and virtually annihilates the motion.

Now the oil presents an elastic fluid medium to the water and isolates it from the air, consequently it is only subject to the first action. The surface of the oil being in contact with the elastic air is acted upon by the second.

The first perpetuates the motion communicated by reciprocal action minus the friction.

second has every tendency to continually resisted by the elasti- the air.

ourse the terms elastic and in- as here used are merely compara- No gas is so elastic but it has of particles, and no solid is so ut that it possesses some elasticity.

G. JOHNSON.

ham, November 14, 1847,

OMOTIVE ENGINE BLAST-PIPES.

—Should the following remarks comotive engine blast-pipes seem of any practical utility, perhaps l favour me with their publication.

I am, Sir, yours, &c.,

ENGINEER.

is always been considered that the iethod of producing that degree t through the furnace and tubes of notive-engine, which is necessary p up the required quantity of is by means of the exhaust steam he cylinders. This however will nd to be contrary to fact, as the ng statements based upon direct ment and well-known and esta- l principles of action in daily on, fully prove:

st, The blast produced by the ex- steam really and virtually consists imber of distinct and successive im- which are by no means equal in o one continuous draught, such as duced by a jet of steam taken from the boiler, by a pipe either d into the boiler itself, or into the pipe for conveying the steam from iler to the cylinders—which is at- l with this farther advantage, that igine driver has it always in his to regulate the blast according to quirements of the engine for the eing.

ond, The pressure required to tained by the boiler is less when t is employed for this purpose in- of the exhaust steam—which is ly an important consideration in as the pressure is reduced, and the nd wear of certain important parts boiler and engine are also corre- ingly reduced. Or if it should be d to work with the same pressure eam in the boiler there will be a r effective power of the engine at iand. Let us suppose that it takes ame quantity of steam to produce equivalent degrees of blast, whether the steam used for this purpose is passed through the cylinders or by a jet pipe from the boiler; if the steam be passed through the cylinders the blast is pro- duced by throttling the exhaust pipe to an extent varying more or less from 3½ to 5 lbs. on the square inch, which will, under the most favourable circumstances, as to form and size of steam passages, produce a back action of 3½ or 5 lbs. on every square inch of the piston, to be deducted accordingly from the effective power of the engine. Mr. Josiah Parkes has estimated this back action at one fifth or one fourth of the whole power of the engine. On what grounds he has come to that conclusion I am not aware, but it must be very near the truth, be- cause the throttling of the exhaust takes place at the very point of escape, which must oppose an increased friction to the issue of the steam through the steam- passages and ports, so that while the in- dicated pressure of steam from the nozzle of the exhaust pipe stands at the lower number of 3½ lbs., it will produce a back action of 5 lbs., or even more, upon every square inch of the piston. If on the contrary the blast be pro- duced by a jet pipe, then the exhaust may be of the finest possible kind, and perhaps instead of being projected into the chimney where it would only impede the draught, it would be better to dis- charge it by a pipe placed immediately in front of and close to the chimney.

Third, The superiority of the jet as compared to the exhaust blast is greatly enhanced from the diminished risk there is of setting fire to the goods' trains or other property situated on the line of rail, the loss from which forms no un- important item in the expenditure of some lines.

LIGHT AND HEAT.

At the last meeting of the American Association of Geologists, Professor Henry, of Princeton, communicated some interest- ing experiments, showing the analogy be- tween light and heat. The experiments were made with a thermo-electrical appara- tus, a very delicate instrument, which will indicate 1-500th of a degree of a Fahren- heit thermometer. It has been long known that two rays of light may be so thrown on each other as to produce darkness. Professor H. showed that two rays of heat might be so combined as to produce cold. Light and

heat differ with respect to the length of the waves—those of the latter are longer than those of the former. Experiments were made upon flames. Some flames give little light, but intense heat; as, for instance, the flame of hydrogen gas. If a solid body is plunged into such a flame, the radiant heat will be increased as well as the radiant light. Experiments made upon the spots of the sun showed that they were colder than the surrounding parts; also that the surface of that body is variously heated. The apparatus was applied to form a thermal-telescope—when turned to the heavens, the coldest part was found to be directly overhead. Thunder clouds, sending forth flashes of lightning, were found to be colder than the surrounding clouds. When turned to the moon there were some slight traces of heat, but those were proved to be from the reflected heat of the sun. He showed this to be the case by an experiment which he performed on ice. In this experiment the ice reflected heat. It has long been known that a burning lens could be made of ice.—*Boston Journal.*

TRAVELLER'S COFFEEPOT.

Fig. 1.

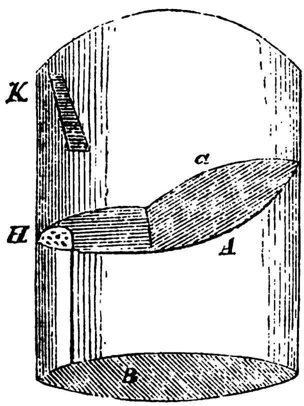


Fig. 2.

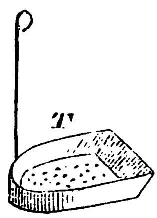
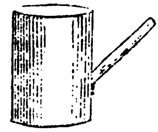


Fig. 3.



Sir,—Of the various coffee machines at present before the public, I think that Platow's is the most satisfactory to use. However, there are, two objections to Platow's machine, which have some weight when it is to be used daily by a traveller; these are, its awkward shape and size, and the necessity which exists that the leather washer or the screws should be air tight. I think that the coffeepot I am about to describe, while possessing all the advantages derived from Platow's principle, will be seen to be a great improvement upon it, in simplicity of construction and in actual bulk.

Fig. 1, represents the coffeepot, one side of which is supposed to be removed. A, is a partition of tin, part of it inclined at *a*. At the edge of this diaphragm is a hole, H, covered with perforated tin: a semi-cylinder of tin soldered to the lower part of the partition, A, at the hole, H, and reaching to within a quarter of an inch of the bottom B, forms a tube open only at the bottom, and the hole, H. All this is stationary. The only movable part of the machine is the little tray, T. Fig. 2, the bottom of which is perforated and of such a figure, as to fit into that part of A, which is horizontal. The mode of making coffee by this machine is the following:

Pour in some water, and when it boils pour in the rest, which will soon sink into the lower part of the pot below, A. Put the coffee in T, and place the tray in its bed. Boil, until the water is sent above A. When the machine has been taken off the fire the coffee will sink into the vacuum below A, and on the removal of the tray may be poured out. In large machines a small strip of tin, placed as K, will serve to direct the stream when pouring it out. Fig. 3, shows the external appearance of the machine. Here

re no valves, screws, or stopcocks, e coffee-grounds may be removed e in the tray, and a new supply of readily applied. We may omit st of the operations detailed, and e tray, T, if the handle be made and furnished with a common cork at the end; which cork must be taken out when the water is to be poured in, or the coffee finally poured out. This modification, from its extreme simplicity would be useful on board ship, &c.

Yours, &c. JOHN MACGREGOR.

24, Lincolns's-inn Fields.

HOROLOGICAL TELL-TALE.

ered under the Act for Protection of Articles of Utility. Richard Sharp, of Westmoreland-street, Dublin, Inventor.

object of this very cleverly contrived e is to register intervals of time by shing in of pins inserted in the dial of nary clock, and so placed in respect acted on by the hand] or hands, that pushed in at the proper time they nain standing evidences of the neglect through which this has arisen:

1, is a front view of clock dial, with gistering pins inserted in it; and fig. section of the dial and registering nism. AA, is the dial, and GG, the 3, lever attached to the dial by a stud, having a steadying piece and stop, *b*; rcular plate, attached to the front of hour-wheel of the clock, which moves arbor of the centre wheel, E, but is its proper position by a spiral spring, vn; F, is the hour-hand attached to ır-wheel; GG, round pins which go h the dial, and when not in actual stand out about a quarter of an inch he surface; H, is a plate attached to k of dial, for the purpose of steady- pins.

action of the apparatus is as follows: ver, B, being pressed in, it comes in t with the hour-wheel, D, and pushes far as the stop, *b*, allows; the hour- again draws the hour-hand after it p to the dial, and if there is a pin, as ınder the hand, it pushes that pin in evel with the dial. But should the e in such a position at the time of its so drawn inwards that it passes be- two pins, neither will be affected by tion of the hand, and any pin thus passed over, cannot be afterwards l in until the expiration of the circle ve hours.

posing, therefore, it were required atchman, that he should every quarter ıour pull a cord so connected with the B, as to press it inwards to the extent d by the stop, *b*, if he did his duty, in in succession would be pushed in, ould he neglect a single interval, the ll remain standing out as a registry t him.

Fig. 1.

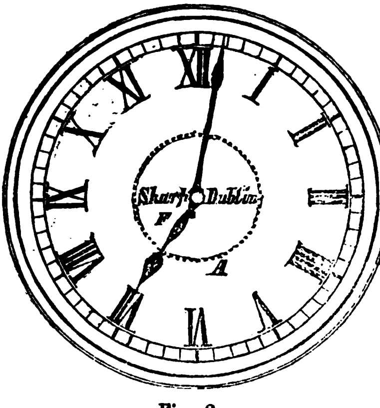
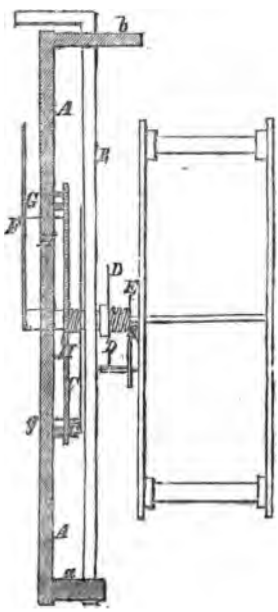


Fig. 2.



BLEWITT'S IMPROVEMENTS IN MALLEABLE IRON.

[Patent dated May 27, 1847. Patentee Reginald James Blewitt, of Lantarnam-abbey, Newport, Monmouth, Esq., M.P. Specification enrolled November 27, 1847.

Pig, or cast iron, is ordinarily prepared for being made malleable by melting with coke in refining furnaces, and keeping it there in a state of fusion exposed to a strong blast and to a great degree of heat.

The produce is afterwards run out into moulds, and becomes what is termed refined iron, metal or plate. It is then submitted, either alone or in combination with pig or other cast iron, to the "puddling" process, and is thus brought into a partial state of malleability.

Mr. Blewitt states that he has discovered that a better quality of refined metal can be produced with less waste of iron, and with less fuel, by using air furnaces instead of refining furnaces. The mode he adopts is this; he heats an air furnace in the usual way, and for each charge puts in about four tons of pig or cast iron of the qualities which he deems most suitable for the production of the required quality of malleable iron. After the charge is properly melted and mixed together it is run into moulds for the after process of moulding, which is conducted in the ordinary way.

The fuel which the patentee prefers to employ for the purposes of his invention is a white-ash, semi-bituminous coal, although he has used one or two hundred weight of charcoal to each charge of iron with advantage.

The patentee claims the employment of the common air furnaces for mixing, purifying, and improving pig or cast-iron, and then subjecting it to the puddling process, and thus producing malleable iron.

THE SPRAY PUMP.

Sir,—Mr. Adcock asserts, "that with the view to depreciate his invention I have endeavoured to make it appear that the blast cylinder at Llanhiddel absorbed from the steam engine very considerably more power than it did, and that from the same motives, I on the other hand have given misstatements wilfully lessening the quantities of water raised.

To show your readers that I have not been influenced by any such motives, I will, with your permission, proceed to analyze his statements, commencing with the power absorbed by the blast cylinder. He states, that "the diameter of the blast cylinder, at Llanhiddel being 50 inches, it would under ordinary circumstances require to work it a 25 in. steam cylinder, and this latter would be *rather more* than 21 horses-power." Now, Sir, the area of a 50 in. cylinder is 1,963 sq. inches, and at a velocity of 240 feet per minute with a mean pressure of $2\frac{3}{4}$ lbs. to the inch, the power exerted will be "rather more than" 39 horses-power. For

$$\frac{1963 \times 240 \times 2\frac{3}{4}}{33000} = 3.92.$$

Again; at a similar velocity (20 double strokes per minute,) but a mean pressure of 4 pounds to the square inch, the power exerted will be "rather more than" 57 horses-power. For

$$\frac{1963 \times 240 \times 4}{33000} = 59.1.$$

This ought to convince Mr. Adcock that I am not "ignorant of the power consumed by blast cylinders," nor have I been "influenced by some other motives than the announcement simply of scientific facts," and "Fair Play" will perceive that my letter was not written "expressly with the view of deceiving your readers"—persons not so easily deceived.

As a *proof* that I have greatly exaggerated the power employed, he states that the power exerted by a 50 inch blast cylinder (at a velocity of 240 feet per minute, and a mean pressure of 4 lbs. to the sq. inch,) is 30 horses, and in *corroboration*, he asserts, that it was worked to that velocity of piston and pressure of blast by an engine of $26\frac{1}{2}$ horses-power! Will Mr. Adcock be so good as to inform your readers by what rule, or under what circumstances, a 28 inch low-pressure condensing-engine is of $26\frac{1}{2}$ horses-power?

Mr. Adcock and "Fair Play" state, that the blast cylinder, 50 in. diameter, now employed at Llanhiddel, was in Staffordshire worked by a 28 inch low pressure condensing engine, and that an engine of that size is $26\frac{1}{2}$ horses-power? This engine is, as they state, "a 28 inch *low-pressure* condensing one," but while the 50 inch blast cylinder was attached to it, the pressure of the steam was more than doubled. The fact is, Sir, the boiler at Tipton is commonly loaded with a pressure of 6 lbs. to the sq. inch; but during the time that Mr. Adcock was experimenting with his spray pump, the pressure was full *thirteen pounds* to the sq. inch—above the atmosphere. This was amply sufficient to work the engine

the blast piston was loaded with a ure of 4 lbs. to the inch, for at this ure of blast it would load the steam- to the extent of 13 lbs. on each ch of its area.

hough Mr. Adcock has not overrated the power absorbed by the blast cylinder, he has greatly exaggerated the work done by the spray pump, for he makes it 1,209 gallons raised 54 feet per minute.

His account of the water stands thus :

Quantity withdrawn from the pit	546	gallons	per minute.
Quantity withdrawn from the adit	173	,,	,,
Incoming quantity.............	490	,,	,,

Or a total of 1,209 gallons per minute.

quantity withdrawn from the pit dif- at slightly from what I gave it (469 s ;) but what does Mr. Adcock mean e 173 gallons withdrawn from the r level? I was assured by persons had seen this level, that it was walled se to the pit, within 2 or 3 feet. How can he claim any water from this ? At the "Public" exhibition the ing quantity was 187½ gallons per e, for when the spray pump was stop- the water was 20 minutes in rising 6 inches. This is at the rate of 30 feet, or 187½ gallons per minute. then, does he make it 490 gallons?

m where the spray pump receives its in the pit to where it delivers it at urface is about 20 feet. This is the "lift" whereby to estimate the work but Mr. Adcock thinks differently. ims as work performed by the spray ; first, the depth of the cistern (19 feet the water line,) in which the bottom spray pump is immersed ; secondly, eight of the receiver above the place the water is delivered in the solid (15 feet ;) and, thirdly, the addi- height to which the water or spray lown when the cover of the receiver emoved, averaging 20 feet, or a total feet. Hence for every 20 feet of lift the spray pump blows the water t. But from Mr. Blewitt's letter it rs that the spray was blown into the the height of 100 feet and more. for every 20 feet of actual "lift," pray pump blew the water 154 feet!! for every 154 horses-power absorbed blast-cylinder, 134 were raised in mere

s goes to prove that the power wasted it the top of the receiver must be ous—nearly five-eighths of the total employed.

. Adcock, asserts "that the body of was so great that the vertical pipe e choked, and the water in the re- stood in a solid state 4 inches above ll mouth." From external appear- this pipe was 9½ inches diameter in mallest part, but a subsequent examina- evealed the cause of its being "choked by the large body of water." Not only was the *bend* at the bottom of the vertical pipe a right-angled one, the worst that could have been adopted, but its upper side projected within the vertical pipe, and by this means reduced the area of the latter nearly one fourth.

Will Mr. Adcock have the kindness to inform practical men what quantity of water a culvert "11½ wide by 8½" deep ought to carry. When was the 12 inch orifice kept constantly full? At the public exhibitions, it was not more than two thirds full.

Mr. Blewitt, states that "the sinkers have always been very much prejudiced against the invention." I do not wonder at their "being very much prejudiced against the invention," for when the common pump was lifting well, the cistern in which the spray pump was immersed would overflow, the surplus water falling on the sinkers below. A man must have a pretty hard head and stiff "till" to withstand the shock occasioned by the descent of 200 or 300 gallons of water from a height of 50 feet or thereabouts.

Mr. Adcock doubts my having been at Llanhiddel during the public exhibitions of the spray pump. I *was* there at a "public exhibition" in the month of June last, but I did not recognize a single scientific or practical gentleman amongst the persons there assembled. Instead of engineers, colliery managers, &c., &c., there were bank directors, iron-masters, merchants, colliery proprietors and shipowners—gentlemen of undoubted honour and position in society, but not suitable persons to judge of the merits or demerits of a patent pump.

At that time I had no intention of publishing the memoranda there obtained ; fully expecting that Mr. Adcock would publish an account of what the spray pump was doing. But three months passed by without so much as a syllable from him on the subject, barring the weekly assertion that it was "perfect" and "successful." It was then that I published, what he is pleased to call, "wilfully erroneous and malicious statements." It was then, and not till then, that we heard of the "practical and scientific gentlemen."

It is now two months since Mr. Blewitt

made the happy discovery that he could sink his pit much faster without the spray pump than with it. Abandoned by every one who has tried it, the spray pump will be remembered as a striking instance of misplaced ingenuity.

Remaining, Sir, your obedient servant,

CASSEL MORLAIS.

Merthyr Tydvil, Nov. 30, 1847.

EXPERIMENTS ON BOILER SCALES.

Professor Johnson submitted to the last meeting of the Franklin Institute (Aug. 19, 1847,) a verbal statement of the result of an examination of the scales adhering to the interior of the boiler of the Government steamer, *W. L. Marcy*.

The specific gravity of these scales is 2·695. They are laminated and crystalline, with minute prismatic columns crossing the thickness of the deposit. The colour is nearly pure white; the side which appears to have been next to the metal is marked with small black specks, apparently of oxide of iron.

Their hardness is such as to allow of their being scratched with a nail, but the side which adhered to the iron is perceptibly harder than the other. Acids produce on them no effervescence or other evidence of reaction.

It had been stated at the time these incrustations were presented to the Institute, that the use of *ammonia* in the boiler, had been found to obviate the difficulty arising from this deposit. Doubts, however, had been expressed whether the remedy were due to a true chemical reaction.

Presuming that by *ammonia* was meant *sal ammoniac*, some trials were made to determine the efficacy of that salt in dissolving the scale, as compared with one or two other reagents applicable to the same purpose.

Having weighed 38 grains of the scale in small fragments, but not pulverized, they were boiled for an hour with 27 grains of chloride of ammonium, (sal ammoniac) in about 4 ounces of distilled water, until no farther effect appeared to be produced. The scales had become rather more friable than before, but their form and structure were unchanged.

The liquid, with the washings of the undissolved fragments, treated with chloride of barium, gave of ignited sulphate of baryta 4·05 grains, proving that about 1·39 grains of sulphuric acid had been already brought into solution.

The undissolved scale, dried at 212°, was found to have lost 2·9 grains, or 7·6 per cent. As the scale had at first been weighed *without drying*, a small part of this loss is probably attributable to hygrometric moisture.

The residue was next boiled in a solution of carbonate of potash;—the resulting sediment separated, washed, dried, and heated a little below redness, and found to be completely soluble, with effervescence, in chlorohydric, nitric, and acetic acids. The solid crystalline scale had, in fact, been converted into a pulpy or flocculent mass of carbonate of lime.

The liquid which had been filtered from sulphate of baryta, after boiling with sal ammoniac, having first been freed from excess of baryta, gave, with oxalate of ammonia, a copious precipitate, showing that *lime* had been dissolved.

On the other hand, the liquid filtered from carbonate of lime, having been acidulated and boiled, gave, with chloride of barium, equally abundant proofs of the presence of *sulphuric acid*.

The foregoing trials prove that sal ammonia *is* capable of reacting chemically to dissolve in part the incrustation; and carbonate of potash to decompose without completely dissolving it;—leaving, at least, carbonate of lime, insoluble and capable, under certain circumstances, of still forming a scale.

It being thus made evident that the incrustation is one of the sulphates of lime, and by negative proofs, ascertained that the clean scale contains no other essential material, an analysis was performed, which resulted in showing that it belonged to the same species as the crystals formerly analysed by Professor Johnston of Durham, containing two equivalents of dry sulphate of lime to one equivalent of water; in other words it was *bi-hydrated* gypsum,

$$=2CaO,SO^3+HO.$$

To prove more exactly the relation between the respective solvents, 10 grains of the scale, freed from dirt, were finely pulverized, heated to dull redness for 20 minutes, losing thereby 3 per cent. of water, and then boiled in three successive portions of a strong solution of sal ammoniac. By this treatment, almost exactly *one-half* of the dried powder was found to have been dissolved. The remaining half was boiled with 20 grains of pure carbonate of potash in 4 ounces of distilled water, by which it was rendered completely soluble in chlorohydric acid.

Wood ashes may probably be substituted for carbonate of potash without serious inconvenience; and to aid the decomposing power, as well as to give completely soluble compounds, acetic acid, or even common vinegar, may take the place of chloro-hydric acid.

To prove the utility of this solvent (the

:e of potassa,) a quantity of acetic was slightly supersaturated with car-e of potash, and a portion of the pow-scale was boiled in the solution for one hour. A few light flocculent par-only remained undissolved, indicating erior facility of decomposition to that oride of ammonium, and yielding ace-f lime and sulphate of potassa—both e salts.

ides the scale of the sea-steamer, trial ade of one, similar in aspect, obtained years ago from a stationary boiler it or near the glass-works of Mr. Bake-in Pittsburg. That scale had, likewise, stalline structure, with small trans-prisms. It had a dirty white colour, arked with black specks on the side had adhered to the boiler, and was, at difficulty, scratched with the nail. not attacked by acids.

ien 19·8 grains were heated to bright ss, for more than an hour, the loss 55 grains, or 2·77 per cent. As the r and lustre of this scale are less re-ible than that of the sea steamer, the ate of lime is doubtless contaminated some earthy impurities, and probably little animal or vegetable matter, but antity of water expelled, clearly indi-that it belongs to the same class of tes as the sea-water scale.

fact, as it is known that a temperature)° expels the water from common gyp-it is inconceivable that true *bi-hydrated* ate of lime should be formed within a , in which prevails a temperature often that limit.

o or three varieties of scale, from s using the water of the Schuylkill, compared with those above described.

: first was from a boiler used at Smith's y, near Fairmount.

s scale is dark grey, and, in many parts, t black. It has a slight scent of animal This odour became abundantly per-le, on heating to 400° or 500°, and the smoke, and strong smell of lamp-oil, no doubt as to the source of this im-. Exposed for ten minutes to a dull at, in daylight, it lost 8·65 per cent., the whole of which was organic r.

ated cold, with chloro-hydric acid, till scence ceased, and then boiled with an of acid, it lost 83·66 per cent. more, g a nearly black powder, (part of was proved to be sulphate of lime,) nting to 7·69 per cent.

nce, the predominant material in this that to which it owes its chief pro-s, is carbonate of lime. Faint traces crystalline structure, already observed in the scale from salt water, and in the Pittsburg scale, were also found in this, and may, probably, be due to the portion of sulphate of lime ascertained to be present.

A second scale, of a character similar to the last, from the boiler of Mr. Coggins, also consists chiefly of carbonate of lime, of a reddish brown colour; and a third from the connecting-pipe of a boiler, which exploded a few years since at Kensington, is of the same general character, but less compact, and of a nearly flesh-red colour. An obvious solvent for this scale, will also be found in acetic acid, or in a substance which can yield that acid to the lime.—*Franklin Journal.*

THE NEW "PONT AUX DOUBLES" AT PARIS.

A new bridge is now in course of erection on the site of the old one of the above name, consisting of a single arch, of which the following are the dimensions:

	metres
Span	31·0
Versed sine	3·10
Thickness of voussoir—	
At key	1·30
At spring	3
Width of abutments	16

Small rough pieces of millstone, worked in promiscuously with Vassy cement, from the concrete blocks of which the bridge is built.

The whole face of the work is now rough, but will be covered with cement worked to imitate freestone.

The bridge is alike remarkable for the novelty and boldness of its design. It is being built under the superintendence of M. de la Galisserie, engineer of the Paris bridges, by Messrs. Gariel and Garnier, who are the contractors.

In order to prove the plan, experiments were made last year, at Vassy, on a model arch of the same section as the "Pont aux Doubles," by a commission nominated by the minister of public works, consisting of Messsrs. Mondot, de la Gorce, De la Galisserie, and Bellegrand, the results of which were so highly satisfactory that it has been adopted for the new bridge.

To avoid any ruptures or fissures in the work, in consequence of the sinking of the centres, the arch was commenced at four places at the same time, and spaces between the voussoirs subsequently filled in. This plan has succeeded, and no crack is perceptible either at the crown or the spring. Amongst other advantages claimed for this system is the rapidity with which the work proceeded, 70 cubic metres being laid on in

on- day. Lightness, economy, and solidity are also mentioned as recommendatory of the plan.

CALENDAR OF SPECIFICATIONS OF PATENTS OF INVENTIONS. FROM THE PERIOD WHEN THE PRACTICE OF ENROLMENT COMMENCED TO THE PRESENT TIME.— CONTINUED FROM P. 286.

From the Reports of the Deputy-Keeper of the Public Records (Sir Francis Palgrave).]

THE CALENDAR.

[Of the two dates annexed to each entry, the first is the date of the patent, and the second that of the enrolment of the specification.]

Christopher Gullett, of Exeter, esq.: of "a safe means and beneficial remedy for expelling the gout from the head, stomach, and vital parts of persons so afflicted, assuaging the paroxysms, even in the most dangerous cases, and afterwards curing such, as well as other gouty persons, without any medicine, plaster, or other such application whatever, either internal or external." [Electricity.] Cl. R., 33 Geo. 3, p. 2, No. 6. April 1, 33 Geo. 3; April 27, 33 Geo. 3, 1793.

Francis Frederick Eckhardt, of Sloane-street, manufacturer: of an "invention and method of preparing linen and cotton cloths with a paste, so as to form a smooth and regular surface, and yet leave the cloth of a pliable quality for the purpose of receiving a coat of water size colours, upon which are afterwards printed ornaments in fine silver and gold or colours in different patterns, so as to resemble damask lace, and various other silk stuffs, which being afterwards varnished, may be washed with water without injury, to be used for hangings and other furniture for rooms. Cl. R., 33 Geo. 3, p. 8, No. 18. April 30, 33 Geo. 3; May 29, 33 Geo. 3, 1793.

Francis Frederick Eckhardt, of Sloane-street, manufacturer: of an "invention and method of preparing and printing paper in different patterns, and to silver it over with fine silver leaves, so as to resemble damask lace and various silk stuffs, to be used for hangings and other furniture for rooms. Cl. R., 33 Geo. 3, p. 3, No. 17. April 30, 33 Geo. 3; May 29, 33 Geo. 3, 1793.

Joseph Huddard, of Islington, Esq.: of "a new manufacture (to wit) a new mode or art of making great cables and other cordage, so as to attain a greater degree of strength therein by a more equal distribution of the strain upon the yarns." Cl. R., 33 Geo. 3, p. 3, No. 16. April 25, 1793; May 25, 33 Geo. 3, 1793.

Joseph Lucas, of Long-acre, oil merchant, and *William Baylis*, of Red-lion-street, tin-plate worker: of an "invention of making, and fitting up, on a new and improved principle, glass and tin and other metal lamps and lanterns, burners, and frames with less glasses, more simple in their construction and mechanism, less expensive in fitting up, and producing a greater proportionable effect of light than any other hitherto discovered." Cl. R., 33 Geo. 3, p. 6, No. 18, October 12, last; Nov. 9, 1793.

Robert Barber, of Bilborough (Notts), gent.: of an improved machine, called the Stocking Frame (otherwise the Gigger Stocking Frame); which said improved machine is particularly applicable for the fabricating and manufacturing of hard-twisted Jersey thread, cotton, silk, and any kind of hard twisted thread or materials into double-looped stocking frame work, exclusive of many other kinds of manufacture for which the said machine, and the particular mode of using the same, may be applied to. Cl. R., 33 Geo. 3, p. 7, No. 17. December 8, 33 Geo. 3; January 7, 1793.

John Curr, of Sheffield, (York,) gent.: of "a mode of applying ropes to the purpose of drawing or raising coals, lead, tin, or any other minerals out of mines, or of conveying goods of any kind in situations where ropes are worked over wheels, rollers, shieves, or pullies," (by substituting one or more ropes of a smaller size for one rope of a larger size.] Cl. R., 33 Geo. 3, p. 21, No. 16. December 17, last past: Jan. 2, 33 Geo. 3, 1793.

Nathaniel Bentley, of Leicester, dyer: of "a machine to be used in the scouring, milling, and washing of hosiery, linen, and woollen cloths and clothing, and other things manufactured and made from wool, cotton, thread, and silk, or any of the raw materials used in those manufactures; a thing never before put in practice." Cl. R., 33 Geo. 3, p. 22, No. 16. January 23, 33 Geo. 3; February 13, 1793.

Joseph Green, of West-hill, Wandsworth, gent.: of "an invention and method of warming rooms and buildings with hot-air of a more pure quality than has hitherto been used." Cl. R., 34 Geo. 3, p. 1, No. 15. December 9, 34 Geo. 3; Jan. 7, 1794.

Patrick Rooney Nugent, of Gray's-inn, esq.: of "an invention of two instruments, whereby the latitude, longitude, and magnetic variation at sea or on shore may be obtained." The instruments are delineated in the margin of the roll, and consist, 1stly, of an universal reflecting septant, sextant, oxtant, or quadrant of a glass tube and bubble, and of a pendulum for taking altitudes without an horizon; and 2ndly, of a steering or universal azimuth compass. Cl. R., 34 Geo. 3, p. 3, No. 13. March 18, 34 Geo. 3; April 7, 1794.

ward Jones, of Bristol, saddler: of invention of a woman's saddle tree, a spring head to fall down, thereby ating danger upon a horse triping, fall- or running away with the rider, who ith ease disengage herself from the , and her clothes prevented from en- ng in the horn or head of the saddle." ., 34 Geo. 3, p. 3, No. 1. May 27, o. 3; June 24, 1794.

es Tate, of Tottenham-court Road, onger: of "an invention of applying the coppers of brewers and distillers, f managing the same in such manner, at very considerable expense will be in the article of fuel, and other ma- advantages gained thereby;" consist- f the following improvements: 1stly, e application of two, three, or more te fires to each copper or vessel, with a te and distinct flue to each fire; 2ndly, e application of a door or register to ff the communication of each fire with opper when necessary; 3rdly, of an ved method of constructing the flues; for the application of bellows or other nes to force fire in particular cases; thly, for an improved method of con- ing the coppers or vessels, in order he fire may be applied to more ad- ge, with sundry other improvements. ., 34 Geo. 3, p, 4, No. 12. June 17, ast past; July 12, 34 Geo. 3, 1794.

n Keylock, the younger, of Hatton- n, Middlesex, gent.: of a new invented tinguisher and fire guard. Cl. R., 34 3, p. 5, No. 9. Aug. 16, 34 Geo. 3; 29, 34 Geo. 3, 1794.

tthew Kemp, of London, looking-glass facturer: of a new invented mill and atus for grinding and polishing all sorts ate and other glass, and washing or ating emery, white lead, colours, and Cl. R., 34 Geo. 3, p. 5, No. 3. Aug, 4 Geo. 3; Sept. 10, 1794.

thony Yeldall, of Cheapside, surgeon: invention of an acromatic belt, which, applied to the human body, has effected singular cures in gouty, rheumatic, ther cases, being a metallic and chemi- mposition, acromatically prepared for urpose of emitting as much magnetic ia as it is possible that any composition concentrated magnet) is capable of. ., 34 Geo. 3, p. 6, No. 4. Sept. 30, o. 3; Oct. 8, 34 Geo. 3, 1794.

ncis Garratt, of Old Swan Stairs, sale tea-dealer: of an invention of ring the cocoa nut with other ingre- , for the purpose of making the same cocoa, denominated (by the specifier) ueen's Cocoa. Cl. R., 34 Geo. 3, p. . 1. Sept. 29, 34 Geo. 3; Oct. 23,

David Mollard, of Maddern, Cornwall, tinner: of a certain machine for moving all kinds of heavy articles, either by raising or lowering them perpendicularly, or by removing them in an horizontal, oblique, or curvilinear direction, or on an inclining or declining plane, or by changing the direction of the said articles from that on which they are moving into other directions, as occasion may require; and in all perpendicular, ob- lique, or curvilinear directions, if required, to keep the action of the weight of the rope or chain, by which any articles are suspended, equal, or nearly so, upon the power working the machine, at all depths whatever, not- withstanding the variable length and conse- quent weight of such rope or chain; and where the articles are moved in any bucket or other vessel by the machine in an hori- zontal, oblique, or curvilinear direction, or on an inclining or declining plane, the same may be emptied or thrown out of such bucket or other vessel by the motion of the machine only. Cl. R., 34 Geo. 3, p. 7, No. 12. Oct. 23, 34 Geo. 3; Nov. 22, 1794.

John Collinge, of Lambeth, patent axletree maker: of an invention and improvement on sugar mills, which will occasion less power to work them, and are not liable to be out of order, by constructing the step blocks to receive the bottom gudgeons of the tmill in any manner, so that the gudgeons therein shall be immersed in oil or grease, nd by providing a recess below the bearing points or cappooses in any manner, so that the foul oil or grease shall escape beneath them, &c. Cl. R., 34 Geo. 3, p. 7, No. 11. Oct 30, 35 Geo. 3; Nov. 29, 1794.

James Key, of Portsmouth-street, tailor; of "an invention of making ladies' elastic habits and gentlemen's coats without seams." Cl. R., 34 Geo. 3, p. 7, No. 3. Nov. 25, last past; Dec. 22, 35 Geo. 3, 1794.

Thomas Fleet, of Preston, Candover, Hants, farmer: of a medicine for prevent- ing the rot in sheep, and which will check the further progress of the said disease in those sheep already infected with it, in such a degree as to render them capable of being fatted on the herbage of the same land which produced or occasioned such disease. Which medicine is called (by the specifier) Fleet's Restorative for the Rot in Sheep. Cl. R., 34 Geo. 3, p. 10, No. 1. Oct. 1, 24 Geo. 3; Oct. 7, 1794.

(*To be continued.*)

INQUIRIES AND ANSWERS TO INQUIRIES.

The Archimedes Screw.—"Is this screw now applied to the lifting of water; and where can one be seen at work?"—R. V. S.

It is not often used now; not so often, perhaps, as it might be with advantage.

Last summer we saw two or three in active operation in the works now going on for the improvement of the harbour of Boulogne. Sir David Brewster mentions one which was erected at the Alum Works, on the water of Leven, and gave great satisfaction; but that was some twenty years ago.

Drying Bleached Linen Yarns.—"L. G. H." should try the plan of the Patent Desiccating Company (Davison and Symington's Patent.) It has been adopted at several bleaching-works with great success. Goods dried by it are said to be as well finished, and to have as high a colour, as those dried in the open air and in the finest summer weather, while at the same time they are dried in a fourth of the time.

"*Couche de Niveau*" means simply any given level; which may be the level either of the sea, or of an inland lake, or of any plain or table land.

Engine Power.—"I purchased lately an engine which was represented to me as being of 12 horses' power. I wish to know whether it is really so. The cylinder is 15 ins. in diameter, and the piston makes a stroke of 4½ ft. The engine, I ought to add, is of the low-pressure sort."—A MANUFACTURER. If the *nominal* horses' power was that meant—which is likely to have been the case, as that is the commercial standard by which sales and purchases of engines are regulated—then our correspondent has had a reasonably good bargain. An engine of the dimensions stated would, if worked at 10 lbs. pressure be fully equal to 11 horses' power.

"*Nature abhors a vacuum;*" so said the philosophers of antiquity: and they said truly. The notion of a vacuum supposes the possibility of any given amount of space being *occupied* with *nothing*. But what is *nothing?*—What, that nothing, which is yet something, capable of occupying space? The definition by Mr. Bourne, referred to by our correspondent, "B. M.," merely evades the question—does not dispose of it. He says, "A vacuum means an empty space—a space in which there is neither water nor air, *nor any thing else that we know of.*"—(*Catechism of the Steam engine.*) We may not know what there is left in a close vessel when the atmospheric air is pumped out of it; but that is no reason, or at best a very foolish one, for saying there is *nothing* left. Both theoretically and practically, a perfect vacuum belongs to the category of things which are inconceivable, and may be therefore safely pronounced impossible.

Amicus.-The *Mathematician* is published by Bell, 186, Feet-street; the *Lady's and Gentleman's Diary* by the Stationer's Company.

James Yates (Burnley.)—Photographic plates are supplied by West, Fleet-street, and by almost all other opticians; also by silver-plate workers.

A Disliker of Steel Pens.—Ivory, from its brittleness, would certainly not answer.

J. S.—Marine glue is composed of caoutchouc, naphtha, and shellac.

NOTES AND TOTICES.

Communication between Passengers and Guards.—"C. B. M." states that by an oversight in his letter (p. 330, current volume,) he limited the position of the alarm-battery to the last carriage of the train; but that such an arrangement is by no means essential to the contrivance—"for that the battery would be equally effective if placed in any part of the train." He adds: "Allow me to indicate one additional advantage which this form of telegraph, where the signal is made by *breaking* contact, has over all the usual ones in which contact is formed to effect communication. It is this—that in a moving train, there being a chance of derangement of the conductors, the old plan would be liable to fail in signalizing, on making contact; the guard might make and re-make contact without provoking any attention, if a wire should have broken. In the present case the instrument would at once betray any imperfection in its capability, and by ringing the bell, would demand reparation."—Mr. E. E. Allen lays claim, in a contemporary journal, to having been the first to propose the plan of "setting going a whistle on the engine, either by making or breaking contact in a metallic circuit passing from end to end of the train, the circuit being partly formed by the connecting side-chains of the carriages." But see what Mr. Rowland says on this head, *ante*, p. 543.

Inhalation of Ether *Superseded.*—A new chemical substance has been discovered which exerts the same influence upon the human system as ether, but is much more readily administered and free from some of the disagreeable consequences that now and then attend the taking of the latter. This substance is called chloroform, or perchloride of formyle; and has little resemblance to ether in its composition. Ether is composed of oxygen, carbon, and hydrogen,—whilst chloroform has no oxygen, and in addition to carbon and hydrogen contains chlorine. This substance was originally discovered by Sonberain and Liebig; but the properties of its vapour were first ascertained a few weeks ago by Dr. J. G. Simpson, of Edinburgh. In order to produce insensibility by this agent—which, like ether, is a fluid, but less volatile—it is not necessary to use a complicated apparatus. Simply sprinkling it on a handkerchief and sponge and applying it to the nostrils during inspiration is sufficient. The effect on the nervous system is produced more rapidly than by ether, and the sleep or insensibility occasioned by the new agent is of a more profound kind than that caused by the old one. The quantity of chloroform required is much less than of ether—amounting in most cases to at least nine-tenths less. Its smell is also much less disagreeable.

Force of the Wind on bodies of Water.—We can form, *à priori*, very little idea of the actual power of the wind in propelling bodies of water, and causing them to accumulate in its own direction. Smeaton states that, in a canal 4 *miles long, the water at one end has been raised* 4 *inches higher than at the other*, by the blowing of the wind along the canal; and Rennell mentions that, *in a lake* 10 *miles broad, and* 6 *feet deep, one side has been driven to the other by a strong wind in such volume, as to render it* 16 *feet deep; while the windward side was laid entirely dry.*—*Edinburgh Review*, Oct., 1847.

The late Mr. James Marsh.—The Board of Ordnance has at last granted to the widow of this distinguished man a pension of *twenty pounds per annum*. Mr. Marsh was well known as the ingenious inventor

rocess for the detection of minute quantities ıic, which led to the important discovery of ; that arsenic and antimony, when taken as , are absorbed and carried into all the struc- f the body. For this and other important ries in chemistry, which obtained for the ɜd deceased an European reputation, his is rewarded by Government with a pension ı shillings and eightpence per week for the ; of herself and family!—*Times.*

l Application of Electricity.—The *Pittsburgh l* notices an invention made by a Mr. Lilly, city, in connection wich Dr. Colton, which o challenge attention, not only for the inge- hich it displays, but the useful results which ises. The machine is a small locomotive, placed upon a circular railroad, around t is driven by electricity. The power is ap ıot to the locomotive, but to the track, and consists the novelty of the invention or dis- Two currents of electricity, negative and ɜ, are applied to the rails, and from thence nicate with the engine. The latter is pro- rith two magnets, which, by a process of al- attraction and repulsion, drive the car over :k. A piece of lead was placed on the loco- , making in all a weight of about ten pounds, the application of the battery the machine with astonishing rapidity up a plane inclined ive degrees. Heretofore the propelling power ɜn used on the car itself; in this instance, ɜr, the power is in the rails, and an engineer remain in one town, and with his battery locomotive and train to any distance required. *'ork Literary World.*

ısmission of the Queen's Speech by Electric ıph.—On Tuesday, the electric telegraph ɔught into active operation on a grand scale, purpose of transmitting the Queen's speech various large towns and cities throughout ıd and Scotland. An early copy of the speech, ly granted for the purpose, was expressed Westminster to the central stations in the and at Euston-square—both of which places hed by about ¼ past one. The manipulators e stations, having touched the wires,—com- ating with every telegraph station through- ɜ kingdom, thereby sounding a bell at each, ving the note of preparation, commenced ng off in a continuous stream along the wires sive sentences of the speech. This operation ed from a quarter past one to a quarter to on the principle lines of telegraph; but con- ɔly less, owing to the greater proficiency of anipulators—on the Eastern Counties and ·Western. It was completed to Southampton, a steamer was in readiness to express the ı to the continent, in about an hour. During ro hours the speech was transmitted over niles, to 60 central towns or stations, where : more manipulators were occupied in deci- g the transmitted symbols. Immediately on its l at Liverpool, Birmingham, Rotheram, Wol- npton, Leeds, Wakefield, Halifax, Hull, Roch- iosport, Southampton, Dorchester, Gloucester ter, Manchester, Derby, Nottingham, Lincoln, ɜld, York, Newcastle, Norwich, Edinhurgh, lasgow, the speech was printed and generally ɔuted; and the local papers published special ıs.—*Daily News.*

ım Helve.—At the last meeting of the ution of Mechanical Engineers, a paper ead from Mr. Smith, of the Vulcan Works, Bromwich, giving an account of a steam of his invention. The principle feature s the economising of the steam, by having a engine to work the force-pump during the ıg of the iron undergoing the process of forg- ınd so reserving the steam till the work is to commence upon. The mode of action is ans of a steam cylinder, placed directly over ead of the hammer and the piston of the ler, connected to the hammer; the steam is applied to lift the hammer up, which descends by its own weight on the work.

CongreveRockets were introduced into the service during the late war, and were first employed at the attack of Boulogne, in 1806, by Commodore Owen. These missiles are contained in metallic cases, the carcases with strong iron heads filled with a composition as hard and solid as iron itself. The penetration of a 32-pounder rocket carcass in common ground is nine feet, and it has been found, in the different bombardments where they have been used, to pierce the walls of solid mansions, and pass through the several floors. * * The Congreve rocket must be looked on as exclusively a British weapon, and its internal structure and composition are as yet maintained in profound secrecy. The French, who have been greatly disconcerted by the introduction of this projectile, pretended more than once to have analysed some of the rockets, and thereby discovered the art of making them; and the Americans boast that they can make them,—better, of course,—than we do at Woolwich. But there is little assurance in asserting, that the foreign chemists are, to a man, at fault; for it is confidently maintained, by those who are behind the curtain, that the art of making these rockets cannot be discovered either by inspection or analysis.—*United Service Magazine.*

The Gun Cotton.—The Board of Ordnance have definitively decided against the adoption of this explosive compound in the military and naval services. The chief objection to it is the very low temperature at which it explodes. The mere heating of a gun from a number of charges fired in succession, has been found sufficient to cause an instant explosion of gun-cotton.

Joyce's Stove.—A curious question has been raised in the Court of Chancery, in the case *Executors of Wilkins against the Britannia Insurance Company,* The deceased, Wilkins, returned from a visit to Hackney, accompanied by a brother-in-law, of the name of Lasserre; and gave directions to the servants at his own residence, in Wilton-street, Belgrave-square, to light fires in two bed-rooms, one for himself and the other for Lasserre. About eleven o'clock at night, Wilkins retired to bed, and, having raked out the fire from the grate, and shut down the register, he brought a Joyce's stove from an adjoining greenhouse, placed it in his bed-room, and closed the doors. On the following morning he was found lying on the bed in an expiring state, and soon after died. The question raised is this: "Was the death of the testator accidental or premeditated?" Or in other words—would any man make such use of Joyce's Stove, who did not meditate suicide?

American Steamers.—The largest steamer ever built is now in course of construction at New York. She is intended to ply on the river Hudson, and will be upwards of 400 feet long. The *Hendrick Hudson,* now running on the same river, measures 341 feet from stem to stern.

An Ether Engine.—For several years, ether has been thought of as a motive power. "The learned and indefatigable M. du Tremblay," says the *Courrier de Lyon,* "has devoted much time, and made numerous experiments, with a view to its application. The problem seems now solved, for, during the past week, an ether engine has been at work at the Guillotière Glass-works; it is estimated to be of 20 horses power, and is used together with a steam-engine of the like power, to drive the glass-cutting and polishing tools."

Lowering a Lake.—A somewhat remarkable undertakiug is at this moment in progress in Sweden, —that of lowering the waters of the great lake of Oleron to the extent of twelve feet. This operation has become necessary, in consequence of the construction of a railway from Stockholm to Gothenburg. It will cause upwards of 10,000 acres to be brought into cultivation.

A Diviner.—Among the smaller *lions,* who are caressed only in the absence of the *premiers sujets,*

will be found an individual possessing great interest, the Curé Parramelle, the humble village priest, who has been sent for by the *Academie des Sciences*, in order to enlighten that respectable *corps* of *savans* concerning the extraordinary gift which he possesses of discovering hidden springs beneath the earth. It is curious to behold the touching simplicity of his manners, and his utter unconsciousness of the importance of the gift with which it has pleased heaven to bless him. It appears that this man's powers are most extraordinary, that *he has never once been deceived*, but told on the instant, without hesitation, the exact spot where water may be found. He is singular amongst those who have hitherto professed the science in his utter independence of the divining rod, which he has never needed. He describes the sensation he experiences when walking over a spring, to be that keen and pricking pain in the throat and nostrils, like that occasioned by the inhaling of phosphorus, or too strong a pinch of snuff.—*Paris correspondent of the Atlas.*

WEEKLY LIST OF NEW ENGLISH PATENTS.

William Betts and George William Jacob, of Wharf-road, City-road, for improvements in th manufacture of capsules, and in the application of designs to certain descriptions of surfaces. November 30; six months.

William Eaton, of Camberwell, engineer, for improvements in machinery for twisting cotton or other fibrous substances. December 1; six months.

Gustavus Moenck, of Wellington-street, Strand, Doctor of Laws, for certa[illegible] improvements in clocks and time-keepers. December 1; six months.

Thomas Chandler, of Stockton, Wilts, for improvements in machinery for applying liquid manure. December 1; six months.

Frederick William Mowbray, of Leicester, paper-dealer, for improvements in machinery for the manufacture of looped fabrics. December 1; six months.

WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

Date of Registration.	No. in the Register.	Proprietors' Names.	Addresses.	Subjects of Designs.
Nov. 26	1270	Dunning, Cooper, & Co.,	Wolverhampton	Tumbler, or lever for locks.
27	1271	John Paterson	Wood-street, Cheapside	Slide for a brace.
,,	1272	Banjamin Lewis Vulliamy	Pall Mall	Watch for travellers.
,,	1273	Henry Jones	Cobridge, Staffordshire	Ventilator.
29	1274	Joseph Stubbs	Thomas-street, Mill-wall	Lubricator.
30	1275	John Yates and Sons	Birmingham	Coffeepot and filterer.
,,	1276	Thomas Marsh	Charlotte-street, Portland-place,	Hand dibble.
Dec. 1	1277	John Mather	Beaufort-street, Chelsea	A three-way-cock.
,,	1278	W. M. W. Pigott	Birmingham	Button-back and shank.
,,	1279	William Newton	Chancery-lane	Adjustable horizon, or terminator, for a globe.

manufacture, and will be very shortly ready

!ers forwarded to the COMPANY'S WORKS, -ROAD, CITY-ROAD, will receive immediate ı.

Haslingden, September 4, 1847.

Sir,—We have now been using the Gutta Straps for the last eight months, and have ;asure in saying they have answered our nguine expectations; and we may add, that our machines which required a 12-inch lea-ıp, and which almost daily required to be , we have been turning the same with the ercha Straps 10 inches only for the above-eriod, and now find them as good as the ' were first applied.

We remain, yours respectfully,

W. & R. TURNER.

Statham, Esq., Gutta Percha Company.

Atlas Works, Manchester, Sept. 1, 1847.

:n reply to your inquiry as to the result of erience with the Gutta Percha Straps, we at pleasure in stating that the advantages sess are so very manifest as to induce us to em in almost every instance where new e required.—We are, Sir, very respectfully,

SHARP, BROTHERS.

:l Statham, Esq., Gutta Percha Company.

Bridgewater Foundry, Patricroft, near Manchester, Sept. 3, 1847.

n reply to your inquiry respecting how we · Gutta Percha Machine Straps or Driving though we have not had quite so much ce in the above-named use of Gutta Percha pe to have, so far as we have employed it, ven us general satisfaction. The beauti-ıight and regular manner in which it runs ulleys, especially on our cone or speed pul-strong recommendation in its favour; and we are inclined to think it does not take grip on the pulley as leather, yet there is ıld for all general purposes. We shall con-use it and to give it our best attention, so rn how to employ to best advantage the cellent qualities it possesses over the ordi-her belts.

NASMYTH, GASKELL, & CO.

tham, Esq., Gutta Percha Works, London.

Manchester, 18th June, 1847.

ir,—We beg to inform you that we have the patent Gutta Percha Bands or Straps r more than six months. For tube frames der them very much superior to anything tried before. They also do very well as ıps for mules, throstles, looms, &c.

re, Sir, yours respectfully,

THOS. DODGSHON & NEPHEWS.

muel Statham, Gutta Percha Company.

Wellington Mills, Stockport, 4th September, 1847.

men,—We have much pleasure in bearing mony to the valuable qualities of the Gutta or driving bands. We have found it answer gly well in most cases where we have tried e think it has only to be made known to s very general use.

:, Gentlemen, yours obediently,

HOLE, LINGARD, & CRUTTENDEN.

Gutta Percha Company, City-road, London.

Tottington Hall, near Bury, Lancashire, September 3, 1847.

ir,—Your letter of the 31st August is to ıd in answer respecting the use of your ercha Bands, I cannot give you a better our approval of them in preference to lea-ps, than having given an order for another artner, yesterday, to be in readiness in case ınt. They are decidedly preferable to the s; and we can recommend them with the confidence to any person for Driving Straps.

For HALL & GORTON, THOMAS GORTON.

S. Statham, Esq., Gutta Percha Company.

Brewery, 16th September, 1847.

Gentlemen,—We have much pleasure in repeating our testimony to the very great improvement effected by the use of Machinery Bands made of your material instead of leather: the stoppage of parts of our works, through the failing of the leather straps, used to be of daily occurrence, causing great inconvenience and expense. With this annoyance we are now never troubled, and are assured by our superintendent that the advantage of using your material is surprising, as regards economy and saving of trouble. We confidently recommend it to machinists and factories for general adoption.

TRUMAN, HANBURY, BUXTON, & CO.

To the Gutta Percha Company.

Patent Gutta Percha Soles for Boots and Shoes.

The capabilities of the GUTTA PERCHA SOLES FOR BOOTS AND SHOES having been extensively and satisfactorily tested, we can unhesitatingly recommend the material prepared for the purpose, its merit having been acknowledged by all who have worn it. Indeed, experience has proved that Gutta Percha Soles wear twice as long as leather, with great additional personal comfort, and they remain perfectly impervious to wet until quite worn through.

23, Southampton Row, 1st Sept., 1847.

Gentlemen,—I write to thank you for allowing me to use the new PATENT GUTTA PERCHA SOLES. I felt annoyed at not being allowed to use them from the time I had first worn them, namely, from last October, but am not sorry now, because I can speak confidently of their advantages over leather soles. I made the first pair last October, and wore them eight months before I wore the soles through. I had them heeled six times, and one pair of extra fronts I put to the same soles. *I only kept the one pair in wear to see how long they would last.* I will never wear another leather sole so long as I can get GUTTA PERCHA SOLES, and I walk from 12 to 20 miles a day.

C. WRIGHT, Boot and Shoe-maker.

To the Gutta Percha Company.

9, Gloucester Row, Hoxton, 5th July, 1847.

Sir,—I beg to thank you for the boots with GUTTA PERCHA SOLES which I had from you on the first of the year. I have had them in constant use for nearly five months, the greater portion of that time being the most inclement period of the year; and from my occupation as a general post letter-carrier, you may be sure that they have had more than a common fair trial, and the Gutta Percha seems now as firm and as little worn as on the first day. W. HUTTON, G. P. O. Letter Carrier.

To E. Granville, Esq., Gutta Percha Works.

28, St. John-street, August 25th, 1847.

Gentlemen,—It gives me great pleasure to acquaint you that the Gutta Percha Soles I had from your Works have answered the purpose admirably, as I can fully testify, having had them in wear six months, during the winter, in Smithfield-market, and have not been subjected to the annoyance of wet feet, as is often the case with leather soles, and, in my opinion, they wear three times as long.

H. I. TARLING.

To the Gutta Percha Company.

N.B.—The above Soles, which are not worn out, may be seen at the Gutta Percha Company's works.

No. 3, Union place, New-road,

Dear Sir,

I have worn the Gutta Percha Soles for nearly a year, with much satisfaction and comfort: in wet and cold weather they keep the feet perfectly dry and warm—are pleasant to wear, and I have found them more durable than leather.

I am, Dear Sir, yours faithfully,

W. GORTON.

To the Secretary of the Gutta Percha Company.

CONTENTS OF THIS NUMBER.

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Edited by J. C. Robertson, 166 Fleet-street.

OOMAN'S PATENT IMPROVEMENTS IN SCOURING AND BLEACHING.

Fig. 1.

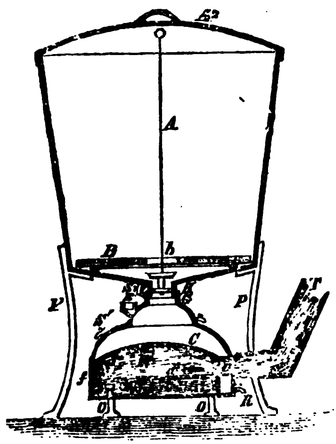
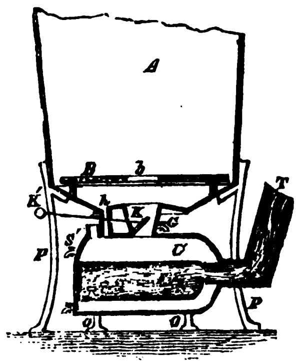


Fig. 2.



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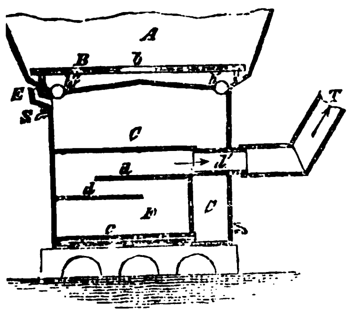

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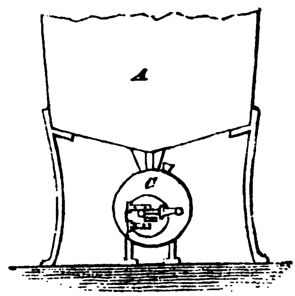

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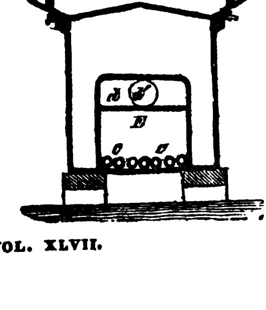
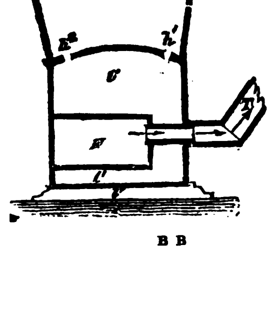


Fig. 4.



BROOMAN'S PATENT IMPROVEMENTS IN SCOURING AND BLEACHING PROCESSES AND MACHINERY.

[Patent dated May 29, 1847. Specification enrolled November 29, 1847. Invention communicated by a foreigner residing abroad.]

The improvements which form the subject of this patent have special relation to the scouring and bleaching of household and body linen, in which processes women are now ordinarily employed; and the advantages claimed as resulting from them are a considerable saving in the quantity of water and fuel used, and a great saving also in time and labour.

Fig. 1, is a sectional side elevation of a scouring and bleaching apparatus of ordinary size, constructed according to this invention. A, is the copper for containing the linen, which has a movable lid, A^2, and a false bottom, B, of wood, on which the linen rests, with an aperture, *b*, in the centre of it, up through which the steam passes. C, is the boiler; F, the fireplace; *f*, the door of the fireplace; *d*, stop plate to keep in the flame and smoke, and cause them to circulate in the direction of the arrows; *d′*, flue; T, smoke pipe; *c*, is one of a series of bars for supporting the fuel; P P, standards which support the copper; O O, the feet or supports of the fireplace and boiler; E, funnel for filling the boiler, which is, or may be, made steam tight by means of a valve opening upwards, and kept shut by a spring acting on the top of the valve; G is the neck of the boiler, which screws on to a tubular piece, H, which projects from the fixed bottom of the copper, A, so that the copper can be separated from the boiler at pleasure. S′ is a test cock, for ascertaining the height of the water in the boiler. The same passage, GH, serves for the ascent of the steam into the copper, and for its return into the boiler after it has passed through the linen and been condensed. The bottom of the copper is slightly sloped, (as shown in the engraving,) so as to facilitate the return of the water into the boiler. R, is a discharge cock. The floor of the fireplace is made of cast iron or sheet iron, and may be covered with tiles or bricks. It is represented in the engraving, (fig. 1,) as provided with fire bars, *c*, on the supposition of wood being the fuel employed; but in this, as in all the apparatuses afterwards described, (except those in which the boiler is under the floor,) either wood, or coal, or coke, or any other description of fuel may be employed, and the arrangements of the fireplace modified accordingly.

The mode of operation is as follows:— The linen having been assorted, is at once thrown into the copper (before lighting the fire) beginning with the foulest. An alkaline solution or bleaching liquid, similar to that ordinarily employed in washing, is then poured in by little and little, till the whole of the linen is saturated with it, the operation being assisted by stirring up the mass by means of a stick without putting in the hands. Any excess of the liquid which may collect at the bottom of the copper is drawn off by a tap, S, and saved for future use. When the soaking is finished, the boiler is filled with water to about the height of the test cock, S′, and the passage of communication, G′ H, between it and the copper opened. The lid of the copper is then put on, and nothing more remains to be done, except to light the fire and to keep it up briskly until the steam begins to force its way out from under the edges of the lid in little puffs. The fire is then lowered, and after a little time the linen is taken out of the copper, when it is generally found in a thoroughly cleansed state. Should any spots or stains still remain, they are afterwards removed by washing it in water, either with or without soap. By separating the boiler from the copper containing the linen in the manner which has been just described, a great evil which is common to all washing apparatuses of the ordinary construction is wholly obviated; namely, the boiling up of the water in the copper after it has become fouled, and its remixture in this fouled state with the articles which are to be cleansed. The only water with which the linen comes in contact in this improved apparatus is the water resulting from the condensation of the steam, and which is returned to the boiler as fast as formed, along with any impurities which it may collect in its progress.

Fig. 2 is a sectional side elevation, and fig. 3 a front elevation of another apparatus, wherein the copper, A, is of a circular form, covers the fireplace and boiler on all parts, and is made in one piece with them. The return of the condensed steam is effected by a passage, *h*, distinct from that, G′H, through which the steam enters. The valve, K, is in this case hinged and raised by means of a rod, K′. Fig. 4, is a sectional side elevation of an apparatus, in which the copper, A, also covers the fireplace and boiler, but is rectangular instead

of being circular, and is entirely distinct from them, being simply placed, when in use, on the top of the boiler. The bottom of the copper is in this case slightly bulged upwards, and the passages, h^1 h^2, for the entry of the steam and the return of the water of condensation, are placed at the sides. Taps of any approved form will

Fig. 8.

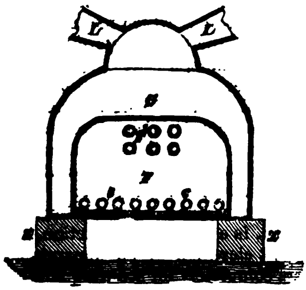


Fig. 10.

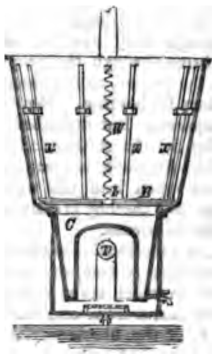


Fig. 11.

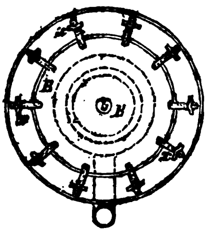


Fig. 12.

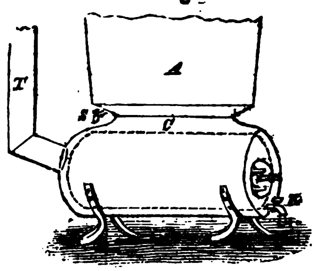
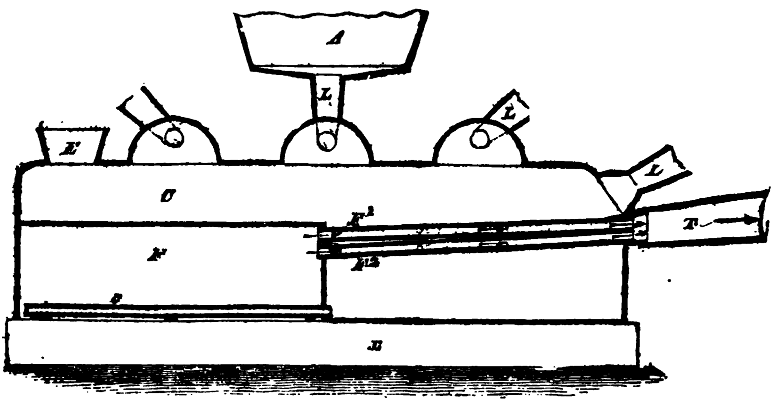


Fig. 7.



suffice to close these passages. The boiler and fireplace are placed on a solid basement, V, instead of on feet.

Fig. 5, is a sectional side elevation of an apparatus of larger dimensions than any of those before described: it rests on an arched

basement of cast iron or brick. The copper is in the same piece with the boiler and fireplace. There are two passages, h^1 h^2, for the return of the water of condensation, and two stop plates, d d, for impeding the course of the flame and smoke, and thereby the better economising the consumption of fuel. The flue, d', before being carried into the chimney, may also be made to take several turns through the fireplace, or even through the boiler, as is commonly done in apparatuses for heating. Fig. 6, is a section of the apparatus last described, on the line, AB, of fig. 5; the grating, c B, forming the floor of the fireplace, is composed of hollow bars which open into the water spaces of the boiler, and thereby greatly accelerate the generation of steam.

Fig. 7, is a sectional side elevation, and fig. 8, a transverse section of an apparatus of large size, in which seven coppers are supplied with steam from one boiler and fireplace. F, is the fireplace, the flooring of which is formed of hollow bars opening into the boiler, as in fig. 6. F^2F^2 are flues, which lead from the fireplace athwart the boiler to the smoke flue. TLL, are pipes for conveying the steam from the boiler to the coppers, AA, three of which are placed on each side of the boiler and fireplace, and one immediately over the smoke flue, T. These pipes, L, are provided each with a tap, so that the steam may be let on or shut off from any number of them, according as may be required. The boiler and fireplace are supported on two short brick walls, xx, and they may be either set in the brickwork or inclosed in a casing of sheet iron, placed at a little distance apart, and so disposed as to present a surface suitable for drying linen. One or two movable caps, E, afford the means of cleaning the apparatus.

Fig. 10, is a sectional elevation, and fig. 11 a horizontal section of a form of apparatus in which the copper and boiler form but one piece. The boiler, in fact, is here but an extension of the copper beyond the false bottom, B; the extension exhibiting in section the appearance of two legs projected downwards into the fireplace. To facilitate the diffusion of the steam throughout the linen, and its return, when condensed, into the boiler part of the apparatus, a spiral rod or open spiral worm, w, of galvanized iron, is fixed in the copper immediately over the central aperture, b, and a number of open perforated tubes, xx, all round it, but nearer to the periphery than the centre of the copper. (Rods and tubes of the same description may be added to any of the other forms of apparatus before or afterwards described.)

Figs. 12 and 13 represent an apparatus similar to the preceding, but one in which the boiler is of one piece with the fireplace, and is in the shape of a cylinder, with double sides, the fireplace being in the middle. The copper may be attached in the manner represented in fig. 13.

Fig. 14 exhibits an arrangement in which the fireplace occupies a very little space, and is placed quite under the boiler, but has a flue leading from it which makes a complete circuit within the boiler before terminating in the smoke tube, T.

The copper may in this case be united to or separated from the boiler. The feet supporting the apparatus may be riveted on to it, or made to screw into it when set up, which will allow of the apparatus being easily packed up when it is required to be exported or removed to great distances.

Fig. 15, is a longitudinal section, and fig. 16 a front elevation of an apparatus which answers completely for scouring and bleaching linen, and serves at the same time all the purposes of a bath. The boiler surrounds the fireplace (except in front), and has a movable metallic cover, d, which rests on ledges, when the apparatus is used to heat water for bathing purposes only. The false wooden bottom, B, of the copper, which it is requisite to employ in washing, is pierced with three or four openings, which are surmounted by as many perforated tubes, besides which there are two perforated tubes, xx, which are carried all along the sides in a spiral or winding direction, so as to allow the steam to pass, and to force itself into every part of the linen. When used as a bath, the perforated tubes and false bottom are removed, or the former only is removed, and the latter retained.

Fig. 17, is a top plan of an apparatus similar to the preceding, only that it is larger, and forms a double or twin washing apparatus and bath—an arrangement which admits of a large or small washing being made in the same apparatus, or of two assortments of linen being differently treated at one and the same time, or of water being heated in one of the compartments and water heated in the other, &c. This is effected by having a longitudinal partition, r, fixed or movable, which divides into two parts the fireplace, the boiler, and the copper. Fig. 18, is a section of the preceding apparatus on the line AB, showing the internal arrangement of the fireplace and the course which the tubes take, through which the hot air and smoke circulate. These tubes may be of any convenient number; but, as in the other apparatuses, they all lead into the chimney T, either directly or circuitously.

The specification next proceeds to

describe a compound apparatus on the same principle as that last specified, having two distinct furnaces, each of which is subdivided into two, and also an entire battery of apparatuses on a like plan, the number of which may be indefinitely multiplied.

Fig. 13.

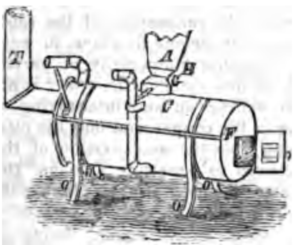
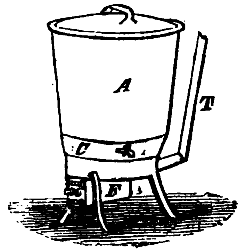


Fig. 14.



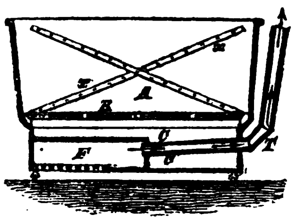


Fig. 16.

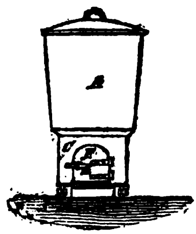


Fig. 17.

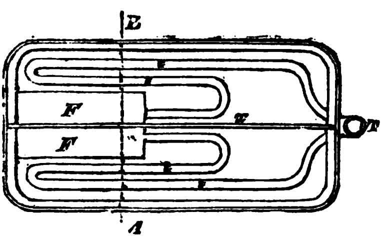
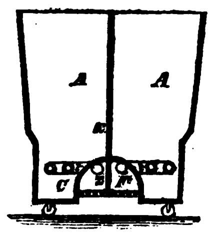


Fig. 18.



Some of the minor details are then gone into more fully, and the specification winds up with the following general observations :

In all the forms of apparatus before described, the coppers are represented as being plain on their inner surfaces ; but they may also be made fluted, which will be attended

with this advantage—that the flutings will afford convenient channels for the ascent of the steam. These flutings should begin at the bottom of the copper, and terminate at about two inches from the top.

Instead, also, of the spiral rods or worms and perforated tubes before directed to be placed in the copper to facilitate the diffusion of the steam, a number of strings or cords of hemp, cotton, wool, or other fibrous material, may be substituted, and suspended from hooks or rings attached to the inside of the copper near the top.

The valve by which the communication between the boiler and copper is opened and closed, has been represented as requiring to be acted on by hand; but it would be preferable in many cases, especially where there are a number of apparatuses under the superintendence of one or two persons, that the valve should be self-acting, so that in the event of its being left accidentally shut after the fire has been lighted under the copper the pressure of the steam should of itself force open the valve. An ordinary clack valve will answer this purpose; but it must be observed that such an arrangement is only admissible in apparatuses where a passage is provided for the return of the condensed steam into the boiler distinct from that through which the steam ascends.

The different forms of apparatus before described being chiefly applicable to the washing of linen, are named by the inventor "Portable and Stationary Economical Washing-Houses," and offer great advantages over all those in common use wherever the scouring and bleaching can be effected by steam without pressure, and great expedition is desirable. Those of the larger sort, (represented in figs. 7 to 17,) may be of very considerable capacity without the bulk being such as to render them at all cumbersome, and will be found particularly suitable for vessels and steamboats of the royal navy and merchant service. By the division of them into compartments, a great saving of space is effected, and the means afforded of washing separately linen of different kinds and of different degrees of foulness, which on board of ship is frequently a great desideratum.

And having now described the nature of the said invention, and the manner in which the same is performed, I declare that the same consists essentially in the general system followed in the conduct of the processes and construction of the machinery before described, rather than in the form or dimensions or peculiar adaptability of any of the parts of the various exemplifications of the said system herein contained, which parts admit one and all of much variation and modification. And that what I claim is; *First*, the scouring and bleaching of linen, by putting the same, without any previous soaking, in a copper, where it is first saturated with bleaching liquid, and then steamed by means of steam introduced from a boiler, separate and distinct from the said copper; as before exemplified and described. And, *Second*, the connecting of the said copper with the boiler and fireplace, in such manner (whether temporarily or permanently) that the foul water in the boiler is prevented from boiling up and intermixing with the linen in the copper, and only the clean water arising from the condensation of the steam is allowed to penetrate amongst the linen; as also before variously exemplified and described.

EUCLID AT CAMBRIDGE.*

Has Mr. Potts made his fortune? Surely it cannot be that a single edition, or a dozen editions of his Euclid, has converted a private tutor at Cambridge into a *millionaire!* Yet how shall we account for a book of about 100 pages, involving an immense amount of thought, and labour, and expense, being presented to the public *gratuitously?* So it is, however;—and as the million-theory will hardly explain the circumstance, we are compelled to attribute this liberal act to an earnest and deep feeling of interest in the cause of geometrical science. It is rare, indeed, to see such proofs as this of disinterested devotion to any science; but rarer still, to the cause of *pure* science.

Nevertheless, even this unselfish generosity does not, *of necessity*, imply that the work itself is of any special value;—it merely proves the author to be in earnest for the accomplishment of what he deems a great and worthy object. Our knowledge of what he has done, however, impressed us favourably, and led us to hope for the new being no discreditable adjunct to the old. Our examination—and a very careful one—of this "Appendix," has convinced us that our augury of hope is realised.

Mr. Potts's edition of Euclid was not one

* An Appendix to the larger Edition of Euclid's Elements of Geometry: containing additional Notes on the Elements, a short Tract on Transversals, and Hints for the Solution of the Problems, &c. By Robert Potts, M.A., Trinity College. 96 pp. 8vo. London: Parker. 1847.

of the *consequences* of the two celebrated "Graces of the Senate" of May, 1846, as it preceded them by some months; but, as is usual when the "academic parliament" adopts a new law, whole shoals of such books subservient to those Graces have appeared, and are daily issuing from the press. To some of these we shall hereafter direct the attention of our readers, and especially with the view of showing how little is the chance of those Graces being carried out, either according to the letter of the law, or in the spirit of the lawgiver. We shall, however, confine ourselves at present to Mr. Potts' little work;—first giving a short account of its nature and character; and secondly, offering a few suggestions as to what, it appears to us, would materially improve a second edition.

To the several books of Euclid Mr. Potts had appended tolerably ample notes explanatory of the character of the ideas and reasonings involved in them. In this "Appendix" he gives some valuable additions to them, as far as regards the 1st, 5th, and 6th books. These are characterised by the same good sense and regard to applicability as the former. Mr. Potts is, evidently, not a Platonist; he rejects, *in initio*, the notion of knowledge being of an origin independent of experience. His note on the doctrine of parallels, and that on the convertibility of Euclid's 5th definition (*lib.* v.), are neat specimens of didactic writing.

The two next articles in the "Appendix" are, perhaps, as important to the young geometer as any that have ever been presented to him within the same compass. The first is devoted to a description of the different kinds of propositions that occur in the Elements, with their distinctive characteristics and the reasons for their several forms. The second is devoted to a discussion, and contains a very full and clear explanation, of the geometrical analysis; describing and illustrating the method of the ancients in respect to the *analysis of theorems* and the *analysis of problems*. We have never before seen in print anything that came so near our views on the subject of analysis; and were it not that the work itself is accessible to every possessor of a copy of the original edition of Mr. Potts' Euclid, we should feel much tempted to transfer it to our pages. All the mystery attached to this subject, and we may add, all the mistiness, which has arisen from the universal practice of combining under one single description the analysis of the theorem and the analysis of the problem, has disappeared under the arrangement adopted by Mr. Potts. No one who carefully studies this chapter in connection with the examples given in the Euclid itself, can fail to form a clear comprehension of the nature of geometrical analysis, or to acquire facility in the use of the method. Nothing appears to us wanting in these chapters, to give clearness to the views of the student on one of the most intricate, and hitherto the least understood, departments of the Greek geometry. We are the better pleased to be able to say this, from our having censured, as incomplete and vague, the article devoted to the subject in the first publication of the Euclid.

We come, in the next place, to a short tract of the doctrine of "*Transversals.*" It is confined, however, to triangles and polygons, cut by one or more rectilinear transversals. It is very neatly drawn up, and *fundamental* theorems only are insisted on. We could wish that at least the circle had been introduced; but, at any rate, a beginning is made, and more ample use of the method will doubtless follow in due time. The subject will have a better chance of attention at Cambridge, from its being of *foreign* origin; and though Mr. Potts has manifested a touch of unusual hardihood in attempting to introduce into the university (in any other way than through college or senate-house papers), either a new term or a new method of research, we trust that the slight sketch he has offered will call some attention to one of the most beautiful systems of geometry of which our age can boast. He has told his readers where they will find more on the subject; but whether the following passage will be palatable to the "Dons," or commendatory of his book to their approbation, is more than we can vouch for. "The only English work in

which the subject is systematically treated, is the last edition of Hutton's Course of Mathematics, in which the theory is applied both to elementary geometry and to properties of the conic sections."—(*Append.* p. 25.) The road, however, is open for any Cambridge man to remove the force, by removing the truth, of this remark. It forms a capital opening for that great writer-of-all-work, the Master of Trinity, to distinguish himself by another contribution to elementary science. Or why should not the suggestion be adopted by the reverend Mr. Colenso, who has heretofore been unable to find game for his pen without poaching on the manors of his brother Cantabs, Lund and Potts?

We come now to the last, and infinitely the most elaborate part of this unpretending volume—the "Hints for the Solution of the Problems, &c." The mere labour of solving above a thousand geometrical propositions is a prospect sufficient to appal most men, even of great mental energy and geometrical power: but when it is considered that a considerable number of these problems are of the highest order of difficulty—higher in order than the most intricate of those that engaged the Greek geometers—the reader will wonder with ourselves at the perseverance and talent which has mastered them in the way they are here done. We feel confident that, as a whole, they have never before been solved in Cambridge; and as to making such questions college and senate-house tests, the very idea is preposterous, even if it do not savour of empiricism. They have been collected during the search for materials for "papers" by those who had "to set the questions," and selected more with a view to *display* on the part of examiners, than with any expectation that they would be resolved by the "questionists." They furnish, indeed, undeniable proof of the *incapacity* of many "examiners" and "moderators" for so conducting an examination as to discover the amount of the knowledge and actual powers of the men. By "a good paper" is meant a paper as unlike all preceding ones as possible, and the greater the number of out-of-the-way difficulties are crammed into it, the more highly is it lauded. This makes such examinations unreasonably difficult, without rendering them discriminative of the men's powers; and it is notorious that success in them is often as much, or more, the result of uncontrolable chances than of either high talent or profound learning. The system is discreditable to the university, and unjust towards the men who go up for the B. A. degree. We see nothing of this kind in the examinations of the Polytechnic School; and we suppose it will not be denied that men have emanated from that school who can bear comparison with any that Cambridge has produced within the present century. This, at least, is one of the monstrosities which the university can correct itself, without the farce of going "to the foot of the throne for new powers or new charters." We may, probably, return to this question in a review of one or other of the "Cambridge Grace-books" very shortly.

We regretted on our first sight of Mr. Potts's "Euclid," to perceive the "corporation spirit" that was manifest in selecting his examples entirely from the Cambridge Examination papers:—it savoured of a narrow spirit,—from which we are, however, most glad to say he has subsequently proved himself altogether free. Mr. Potts knows as well as we do, that not one in twenty of that vast arcanium of questions originated with the Cambridge men who set the several papers which he has quoted; and, in truth, it would be next to impossible for any one to say where they *first* appeared—though easy enough to say where the far greater part of them appeared before they found their way to Cambridge. This, however, is *one* of the means by which the reputation of the University is maintained: the problems are brought together in an accessible and useful form by such works as this from time to time appearing in Cambridge; and because, at some by-gone time, they have been incorporated amongst the papers employed for scholastic purposes in the University:—they become, by tradition, real Cambridge discoveries! We are, indeed, quite convinced that no *motive* of such kind could have been at the bottom of this collection, and we rather

pon it as a kind of deferential homage
; all-powerful authority—public opi-
enshrined in the narrow circle of
'sity gossip. Whatever is the cause,
ret it; for, by looking beyond the
limits to which Mr. Potts confined
, he would have found problems and
na in abundance, of far greater beauty
structiveness than many of those
ne has printed. Still, amongst these
ny propositions of great beauty and
imate difficulty, and such as, (with
ggestions for their solution in the
dix) the student will find to be of in-
ble assistance in the formation of his
rical taste, and the development of
metrical faculty. Without some such
" as Mr. Potts has given, the collec-
ust have become "a dead letter;"
t only would the great majority of
e beyond the reach of the "men,"
re are bold to affirm, beyond the
of the college tutors themselves.
the present century, geometry
en gradually eliminated from Cam-
; and even the geometrical prob-
hat have been done (either in the
s or the senate-house), ***have been done exclusively by the method of co-ordi- or by trigonometrical formulæ, for han thirty years.*** Will any modera-
college tutor gainsay this? We ap-
them to substantiate our assertion—
gh we know it independently of their
tication. The papers on geometry,
n the senate-house, have been de-
l to us by men who knew well what
id, as "*perfectly disgraceful*," and
e known "high wranglers" (we will
y *how high*), who could not demon-
a very common-place proposition in
lid" in a strictly geometrical manner!
ill tell the *meaning* of the "graces"
year: matters had arrived at a pitch
able even in Cambridge. It yet re-
to be seen what interpretation the
sity will put upon its own law, by
estions proposed at the first senate-
examination, conducted according to
w, in January next. We will hope
. If, however, a fair portion of geo-
metry be mingled with the other subjects, and this geometry be *formally* required to be given in the manner of the ancients, we shall not have hoped in vain: if not, we shall consider the whole proceedings to be a bungling attempt to get up a scientific farce. If the law be meant to operate, Mr. Potts' "hints" will be a most valuable present to his University: if otherwise, it will be only remembered in academic history as one of those futile attempts to restore the study of the finest specimens of human reasoning that has graced the world, and to which the "go-by" was given by the manœuvres of men who did not openly dare to express their hostility to the principle. We *hope*, however, for better results—that the present moderators will perform their (*now critical*) duties with honesty and ability. Much of the future character of the University-studies depends upon the moderators of next year, Messrs. Gaskin and Stokes. Neither of them is new to the office; an we trust they are alive to their great responsibility at the present juncture. Let it be remembered that we are no advocates for *superseding* analytical and physical science by geometry. We should on the contrary deeply regret to see either science, even partially, neglected in the University,—as much as we now lament to see the *almost total neglect of pure geometry*. The due culture of the human mind, and the imperative demands of society, are best fulfilled by a *due union of all*. We are no partisans in this matter.

The "Hints" are not to be understood as propositions worked out at length, in the manner of Bland's problems, or like those worthless things called "Keys," as generally "forged and filed,"—mere books for the dull and the lazy. In some cases references only are made to the propositions on which a solution depends; in others, we have a step or two of the process indicated; in one case the analysis is briefly given to find the construction or demonstration; in another case the reverse of this. Occasionally, though seldom, the entire process is given as a model; but most commonly, just so much is suggested as will enable a student of average

ability to complete the whole solution—in short, just so much (and no more) assistance is afforded as would, and *must be*, afforded by a tutor to his pupil. Mr. Potts appears to us to just have hit the "golden mean" of geometrical tutorship.

We do not know whether the following suggestion will be palatable to Mr. Potts or not: we must take our chance—and if he do not adopt it, perhaps somebody else may;—possibly even Mr. Colenso, who appears so much in want of a Mentor to put him in *the way of doing something of* HIS OWN, may be thankful to us for it,—should Mr. Potts (to whom we offer it) decline our proposition. It is this:

(1) That the easier deductions from each of the books, *and these only*, be appended to the several books of "Euclid;" and these arranged in nearly the order of the propositions on which they depend. Those on the first book being such as involve only *very few steps* in each solution; and gradually increasing in complexity as the student becomes more practised in demonstration.

(2) That where several properties of the same figure may possess any remarkable relation, or be capable of becoming ultimately subservient to the investigation of such, they should be classed together; and in the *order* which, upon careful examination of the different modes of deduction, shall appear to Mr. Potts to be the most natural—especially no one being put down before another from which it can be more simply deduced.

(3) That no proposition of considerable difficulty shall be given in the series which is attached to the first six books, as it may be presumed that these will be taken by the student concurrently with his first reading of those books. For the most part, these propositions must be of an isolated character, in order that those which would form parts of a class, may hereafter be disposed of under that classification.

(4) That a sketch of the ancient problems be made an immediate supplement to the Elements: such as the data, the tangencies, &c.

(5) That such inquiries as have grown up in modern times should be distinctly treated, and with moderate fulness:—such as, *centres of similitude*, *radical axes*, *transversals* (more fully than Mr. Potts has given it), *harmonicals*, *anharmonic ratio*, and some others.

(6) That a suitable addition to that meagre compendium on the line and plane given in the eleventh book be made; so as at least to embody the propositions which are *essential* to enable the "men" to even comprehend the figures which are proposed to them respecting three dimensions. At present a few vague notions (which are ludicrously imagined to be generalities) deduced from co-ordinate considerations, is the utmost stretch to which a Cambridge mind can attain. No clear co-ordinate conception can, however, be attained without the aid of Descriptive Geometry; and certainly not the least hold can be gained upon this without an ample preliminary knowledge of the properties and intersections of the line and plane in space, apart from all projective considerations.

(7). Above all things, we entreat Mr. Potts to divest himself of the fanciful idea under which his collection of problems appears to have been originally made:—that the geometry of the Cambridge "papers" is the most complete and consistent possible. His *history* of the problem of inscribing polygons in the circle (p. 94), betokens extended geometrical reading and acquaintance with many books; and his fair quotation of other authors than French and Cambridge ones, in various parts of his *brochure*, bespeaks a mind free from bigotry in these matters. Let him throw off his social shackles, and make his selection of problems from all accessible sources. He may take Cambridge papers; the English periodicals (which are doubtless, indeed evidently, familiar to him); and the foreign journals,—such as those of Hachette, Gergonne, Crelle, Terquem, Quetelet, &c. He may cull from the works of the older geometers—those who flourished in the brightest days of science, both in Britain and on the continent. He may thereby hasten the period when the names of the Andersons, of Maclaurin, Halley,

Simson, and Stewart—the names of Vieta, Stevin, Gregory, St. Vincent, de Billy, Grandi, Pascal, Desargues, and Hugo d'Omerique—shall cease to be viewed, as they now are, as so many resuscitations of "Rip Van Winkle, of Sleepy Hollow," conjured up to disturb the serene apathy of the sluggish Cam.

But we desist :—we shall frighten *Alma Mater* from her propriety by the magnitude of our proposed changes. The good old lady will at once think we project sending a Royal or Parliamentary Commissioner to feel her pulse! No, nothing of the kind :—we are only offering a few straightforward, simple suggestions to one of her dutiful sons, towards whom, for what he has already done for geometry, we feel the greatest respect. With *her* encouragement he may still go on, and gain new honours, both for his University and himself—the honours that attend a life of real usefulness. He has proved himself a geometer of great power and large acquirements, and he deserves the encouragement and support of all who have the welfare and honour of Cambridge at heart.

PROOF OF LEGENDRE'S THEOREM FOR THE REDUCTION OF A SPHERICAL TRIANGLE TO A PLANE TRIANGLE.

[The mention which we made in our review of Mr. Gaskin's "Solution of Trigonometrical Questions," (*ante*, p. 436,) of his method of proving Lhuillier's theorem for the spherical excess, has induced Mr. Gaskin to favour us with the following proof of Legendre's theorem for the reduction of a spherical triangle to a plane triangle, whose sides are equal in length to those of the spherical triangle. Like all Mr. Gaskin's original productions, it is remarkable for its precision, beauty, and clearness. The ordinary proof is intricate, and we have never before met with any attempt to simplify it, except in Snowball's Trigonometry, where the result is obtained by a balance of errors. Ed. M. M.]

Let A', B', C', be the angles of the spherical Δ whose sides are a, b, c;

A, B, C, the angles of the plane Δ whose sides are a, b, c;

$A'=A+\delta A$; $B'=B+\delta B$; $C'=C+\delta C$; $\therefore$ E the excess $=\delta A+\delta B+\delta C$ (1.) since $A+B+C=\pi$:

$$\text{Also, } \frac{\text{Sin. }(A+\delta A)}{\text{Sin. }(B+\delta B)}=\frac{\text{Sin. }a}{\text{Sin. }b}\text{; or } \frac{\text{Sin. }A+\text{Cos. }A\delta A}{\text{Sin. }B+\text{Cos. }B\delta B}=\frac{\dfrac{a}{r}-\dfrac{a^3}{6r^3}}{\dfrac{b}{r}-\dfrac{q^3}{6r^3}};$$

$$\therefore\ \frac{\text{Sin. }A}{\text{Sin. }B}\left\{1+\text{cot. }A\delta A-\text{cot. }B\delta B\right\}=\frac{a}{6}\left\{1+\frac{b^2-a^2}{6r^2}\right\}\text{ and }\frac{\text{Sin. }A}{\text{Sin. }B}=\frac{a}{6};$$

$$\therefore\ \text{Cot. }A\delta A-\text{cot. }B\delta B=\frac{b^2-a^2}{6r^2}=\frac{a^2}{6r^2\,\text{Sin. }^2A}\left\{\text{Sin. }(B-A)\text{ Sin. }(B+A)\right\}$$

$$=\frac{1}{6r^2}\,\frac{a}{\text{Sin. }A}\,\frac{b}{\text{Sin. }B}\,.\,\text{Sin. C. Sin. }(B-A)$$

$$=\frac{ab\text{ Sin. C}}{6r^2}\left\{\text{cot. A}-\text{cot. B}\right\}$$

$$=\frac{E}{3}\left\{\text{cot. A}-\text{eot. B}\right\}\text{ when reduced to seconds.}$$

Since the surfaces of the plane and spherical triangles are nearly equal.

Hence, $\text{cot. A}\left\{\delta A-\frac{E}{3}\right\}=\text{cot. B}\left\{\delta B-\frac{E}{3}\right\}$ and similarly $=\text{cot. C}\left\{\delta C-\frac{E}{3}\right\}$.

Let $\delta A-\frac{E}{3}=m$; $\delta B-\frac{E}{3}=n$; $\therefore\ \delta C-\frac{E}{3}=-(m+n)$ from (1.)

$\therefore\ m\text{ cot. A}=n\text{ cot. B}=-(m+n)\text{ cot. C}$; or

$m\text{ cot C}=-n\left\{\text{cot. B}+\text{cot. C}\right\}$; hence $m\left\{\text{cot. A (cot. B}+\text{cot. C)}+\text{cot. B cot. C}\right\}=0$;

but $\left\{\text{cot. A (cot. B}+\text{cot. C)}+\text{cot. B cot. C}\right\}=1$; $\therefore\ m=0$; or $\delta A=\frac{E}{3}$: Similarly $\delta B=\frac{E}{3}$; $\delta C=\frac{E}{3}$.

ON INDETERMINATE COEFFICIENTS AND ON BERNOULLI'S NUMBERS.

BY PROFESSOR YOUNG OF BELFAST.

[The following addendum to Professor Young's paper on this subject was received before our last Number was issued, but not in time for insertion in its proper place.—ED. M.M.]

If in the foregoing expression for A, a be supposed of such a value as to render A equal to 1, then representing that value of a by e, we have

$$e^x = 1 + x + \frac{x^2}{1.2} + \frac{x^3}{1.2.3} + \frac{x^4}{1.2.3.4} + \&c.$$

By the aid of this we may readily obtain the development of the function

$$\frac{x}{e^x - 1},$$

a development of frequent use in several parts of analysis. I advert to it here as the process by which I propose to obtain it, will illustrate a method of applying the principle of indeterminate coefficients which is generally applicable; and which dispenses with much of the symbolical work usually introduced.

It is plain that if the preceding series for e were actually substituted in the function proposed, the leading term of the sought development, arranged according to the ascending powers of x, would be 1: we may therefore assume

$$\frac{x}{e^x - 1} = 1 + Ax + Bx^2 + Cx^3 + \&c.$$

$$\therefore x = \left(x + \frac{x^2}{1.2} + \frac{x^3}{1.2.3} + \frac{x^4}{1.2.3.4} + \&c.\right) \times$$
$$(1 + Ax + Bx^2 + Cx^3 + \&c.)$$

As this is an identical equation, the product furnished by the second member must be such that the coefficients of the powers of x, after x itself, must be severally zero. Now it is evident that the coefficient of x^2 is got by fancying the first two terms of the multiplier, viz. $1 + Ax$, to be *reversed;* and then multiplying them each by the term above it: in like manner the coefficient of x^3 is obtained by reversing the *three* leading terms of the multiplier, and proceeding in like manner; and so on to any extent. We thus get

$$A + \frac{1}{1.2} = 0$$

$$B + \frac{A}{1.2} + \frac{1}{1.2.3} = 0$$

$$C + \frac{B}{1.2} + \frac{A}{1.2.3} + \frac{1}{1.2.3.4} = 0$$

$$D + \frac{C}{1.2} + \frac{B}{1.2.3} + \frac{A}{1.2.3.4} + \frac{1}{1.2.3.4.5} = 0$$

&c. &c.

which establishes the law of the coefficients, and for their actual values give

$$A = -\frac{1}{2},\ B = \frac{1}{2.6},\ C = 0,\ D = -\frac{1}{2.3.4.30},\ \&c.$$

$$\therefore \frac{x}{e^x - 1} = 1 - \frac{1}{2}x + \frac{1}{6}\frac{x^2}{2} - \frac{1}{30}\frac{x^4}{2.3.4} + \&c.$$

The numbers

$$1,\ \frac{1}{2},\ \frac{1}{6},\ \frac{1}{30},\ \&c.$$

are called *Bernoulli's numbers.*

It may not be altogether out of place to add further, that the method here illustrated in reference to the management of indeterminate, or rather of conditional coefficients, may be employed with advantage in the multiplication of any two series *together,* which proceed according to the powers of x, more especially when the

coefficient of a specified power in the product is alone required;—taking care, of course, to replace absent terms by zeros. Thus, the coefficient of x^4, in the product

$$(a + bx + cx^2 + dx^3 + ex^4 + \&c.) \times$$
$$(a_1 + b_1x + c_1x^2 + d_1x^3 + e_1x^4 + \&c.),$$

is found, as above, to be

$$ae_1 + bd_1 + cc_1 + db_1 + ea_1$$

In like manner, if there be three series, we may find, as in the above illustration, all the terms in the product of two, up to that involving the specified power inclusive; and then, as here, introduce the third series to find the coefficient of that power in the product: and so on for any number of series.

The method may obviously be varied by multiplying the coefficients in cross order.

STUBB'S IMPROVED LUBRICATOR.

[Registered under the Act for the Protection of Articles of Utility. Joseph Stubbs, of No. 1, Thomas-street, Mill Wall, Poplar, engineer, Proprietor.]

Fig. 1.

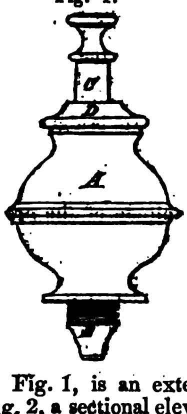


Fig. 2.

Fig. 1, is an external elevation, and fig. 2, a sectional elevation of this instrument. AA, is an outer case, which contains the oil to be used in lubrication; B, is a screwed neck, by which it is fixed to the pedestal or brass of the bearing upon which it is applied; C, is a graduated spindle, the lower end of which forms a valve, which, as it is lifted further up from its seat, allows of a proportionately greater quantity of oil to escape from the aperture, *a*, through a narrow slot, *b*, which is cut in the side of the tube, C, of the valve spindle. The graduations upon the spindle, C, indicate the length the valve is lifted, and consequently the quantity of oil allowed to pass. *d*, is a spring, which keeps the valve at any height it may be set to; and *e*, is a small pin projecting from the side of the spindle, which keeps the slot, *b*, always clear of anything which would obstruct the passage of the oil. D, is a cover to the case, A, which prevents the spilling of the oil by any sudden jar.

By these arrangements the oil may be supplied to the journal in drops, at greater or less intervals of time, according to the size and requirements of the parts to be oiled; and this, no doubt, is a great improvement.

ON LIGHT UNDER THE ACTION OF MAGNETISM. BY JAMES COCKLE, ESQ., M.A., BARRISTER-AT-LAW.

In a paper "On the Equations applying to Light under the action of Magnetism," published in the *Philosophical Magazine* for June, 1846 (vol. xxviii., pp. 469 – 477), the Astronomer Royal has shown that the phenomena observed in some experiments of Dr. Faraday are capable of being represented by the equations (Ib. p. 475.):—

$$\frac{d^2Y}{dt^2} = A.\frac{d^2Y}{dx^2} + C.\frac{dZ}{dt},$$

$$\frac{d^2Z}{dt^2} = A.\frac{d^2Z}{dx^2} - C.\frac{dY}{dt},$$

where x is measured in the direction in which the light is supposed to travel and Y and Z in directions perpendicular, as well to each other as to that just mention-

tioned: so that Y and Z are the displacements of a particle which in its state of rest is situate in the axis of x, at a distance x from the origin. The Astronomer Royal has not however given any mechanical explanation of the phenomena.

When that paper was published it occurred to me that the proposition enunciated (between inverted commas) in the concluding part of it (Ib. p. 477), offered no more difficulty than is involved in the equation

$$\left.\begin{array}{c}\text{Centrifugal}\\ \text{force}\end{array}\right\} = \frac{(\text{velocity})^2}{\text{radius of curvature}};$$

but my investigations on this subject were stopped by my finding that some formulæ given by Mr. O'Brien in the *Philosophical Magazine* for November 1844, (vol. xxv., pp. 326—334,) might be easily made to coincide with those of the Astronomer Royal.

Mr. O'Brien makes (Ib. p. 329, art. 8,) the axis of z coincide with the direction of the propagation of waves; and (compare arts. 9 and 8,) he takes ξ η as the displacements, measured in directions perpendicular to z and to each other, of a "slice" whose distance from the plane of xy is z.

In Mr. O'Brien's equations (1.) and (2,) (Ib. p. 331) make $T=0$; further, suppose the polarization to be circular, and, as in such case we are at liberty to do (Ib. art. 10), put

$$\frac{N}{v}=C$$

C being a constant: then the equations (1.) and (2.) just alluded to become respectively—

$$\frac{d^2\xi}{dt^2}=A\frac{d^2\xi}{dz^2}+C\frac{d\eta}{dt},$$

$$\frac{d^2\eta}{dt^2}=A\frac{d^2\eta}{dt^2}-C\frac{d\xi}{dt},$$

which will become identical with those of the Astronomer Royal on our substituting, as we may do without error, for ξ, η and z, the quantities Y, Z, and x, which correspond respectively with each other in the notation of the two papers.

I may perhaps at another time offer a few remarks on the mechanical considerations involved in the equation $T=0$. The fact that the Astronomer Royal gives his equations as those of a "particle," and Mr. O'Brien his as those of a "slice" will not, I think, be found material in the above discussion. I would add, that I believe that the equations of the lamented Professor MacCullagh for light transmitted through quartz, turpentine, &c., admit of a mechanical explanation not very different from the foregoing.

2, Church-yard-court, Temple,
December 3, 1847.

ON THE CONSTRUCTION OF RETAINING WALLS.

Sir,—Retaining walls are seldom built, unless in cases where it is inexpedient to interfere with the natural surface of the ground beyond the limits of the work, or where it is necessary to retain the earth at a greater angle than the natural slope in cutting or embanking would permit. When such walls are used, great care should be observed in their construction; for from the uncertainty of the pressure to which they are occasionally subjected, few classes of work demand greater skill and attention on the part of the engineer or contractor, and simple as they may appear, considerable science is involved in their construction. In bridges and most other works in Railway engineering, the forces opposed to the structure are easily defined, and no variation either in the direction, or magnitude of the pressure, can take place beyond certain prescribed limits, which are obtained by calculation. In some structures (skew bridges for instance) the calculation, it is true, becomes somewhat tedious, and the projections difficult, but the result is certain, and if we proceed on geometric principles no failure can take place.

Retaining walls have to resist the horizontal pressure of that prism of earth in the rear of the wall, which would, were it not prevented, detach itself from the bank, and sliding down, form the natural slope.

The pressure being horizontal, the tendency to failure is—

1st., That should the resultant of pressure intersect the extrados, the wall would turn over at that point.

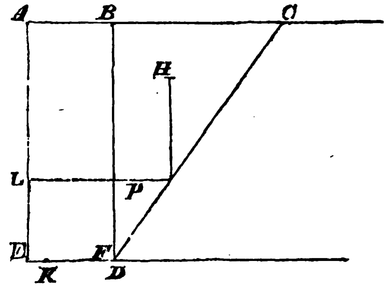
2nd., That the wall may be thrust bodily forward, causing the stones built in it to slide on each other.

If the pressure at the rear of the wall remained constant, it would be exceedingly simple to calculate the form and dimensions best adapted for resisting it; but the most careful drainage cannot insure this, for water will, to a greater or

xtent, penetrate the bank of earth ı the wall retains; increasing there- specific gravity, and at the same lessening the natural angle of ele- ı, and causing a larger prism of of increased weight to be pressing st the wall. Besides, unless egress und for the water it will penetrate oints of the masonry, and by so lessen the resistance of the ad- g parts, or it may saturate the ation, and cause the whole to be d bodily forward—an instance of ı occurred in the Birmingham, ıl, and Thames Junction Railway, ; a retaining wall, 50 yards long, was d off its foundation to a distance rd of 8 feet.

e subject of retaining walls has been treated by Culomb, Navier, and ory (to the last of whom I would the English student for a full in- ation of the theory;) little there- emains to be done; and if the fol- g remarks are of any service it will ise from adding to their researches, rom simplyfing the results and ; them perhaps a more practical ation.

Fig. 1.



The retaining wall, ABEF, (fig. 1,) has to resist the horizontal pressure of the prism of earth, BCF, which would otherwise slide down CF, and form the natural slope of the earth. The pressure demonstrated to be

$$P=\tfrac{1}{2}\,\mu x^2 \tan.^2\left(\frac{\pi}{4}-\frac{\phi}{2}\right)\ldots\ldots(1;)$$

Where μ = the weight of a cubic foot of the earth x = the height BE, and ϕ the angle of elevation of the nature of the slope of earth.

By a well-known theorem in plain trigonometry

$$\left(1-\tan.^2\left(\frac{\pi}{4}-\frac{\phi}{2}\right)\right)\tan.\left(\frac{\pi}{2}-\phi\right)=2\tan.\left(\frac{\pi}{4}-\frac{\phi}{2}\right)$$

e,

$$\tan.\left(\frac{\pi}{4}-\frac{\phi}{2}\right)=\tan.^{-1}\left(\frac{\pi}{2}-\phi\left(\sec.\left(\frac{\pi}{2}-\phi.\right)-1\right)\right.$$

$$=\text{vers.}\left(\frac{\pi}{2}-\phi\right)\sin.^{-1}\left(\frac{\pi}{2}-\phi\right)$$

$$=\frac{\textit{Length of slope}-\textit{perpendicular height};}{\textit{Horizontal base of latter.}}$$

$$=\frac{L-x}{H}.$$

nce,

$$P=\tfrac{1}{2}\,\mu x^2\left(\frac{L-x}{H}\right)^2\ldots\ldots\ldots\ldots\ldots(2.)$$

w the force, P, tends to turn the ound the point, E, with a mechani- ect, $\overline{P.EL.}$, and the resistance op- by the wall is

$$=\frac{\mu_1.\overline{AE}.\overline{EF}^2}{2},$$

: μ_1 = the weight of each cubic foot aterial in the wall, put t = EF, and

$$LE=\frac{AE}{3}=\frac{x}{3}-,$$

and for security, instead of referring the moment of action to the point E, let them be referred to the point K, situated within the extrados, and put $EK=\frac{t}{n}$, when

$$\frac{\mu_1\cdot\overline{AE}.\overline{EF}^2}{2}\text{ becomes}=\mu_1\overline{AE}.\overline{EF}(\tfrac{1}{2}EF-EK)=$$

$$\mu_1 \nu t\left(\frac{t}{2}-\frac{t}{n}\right)=\mu_1\chi t^2\left(\frac{n-2}{2n}\right)$$

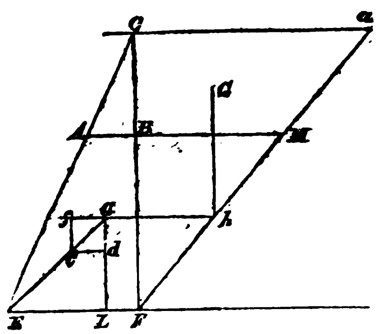
and therefore,

$$\mu_1\chi t^2\left(\frac{n-2}{2n}\right)=\tfrac{1}{2}\mu\chi^2\left(\frac{L-x}{H}\right)^2\tfrac{1}{3}\chi$$

$$\therefore\ t=\frac{\chi(L-\chi)}{H}\sqrt{\frac{n\mu}{3\mu_1\,(n-2)}}\ \ldots\ldots\ldots\ldots\ldots(3.)$$

Retaining walls with rectangular sections are, however, seldom used, for it is evident that if the wall is made thick enough at the base to ensure stability, it will be thicker than is necessary at the top. The material is therefore greatly economized if built in the form EABE, (fig. 2.)

Fig. 2.



If CaF, (Fig. 2,) be the prism of earth supported by the retaining wall of the angular section, ECE; G the centre of gravity of the earth; and G_1 the centre of gravity of the wall. Draw the line G*h* perpendicular to the horizon, and *h*G*f* parallel to it, also through G_1, G_1 L perpendicular to G*h*, and set *cd* equal to the weight of the wall; make *cf*=P; then will *ce* be the resultant of the pressure P, and the weight of the section CEF.

Since EF is a function of CE, and CF = χ, EF=$\tau\chi$, suppose. Then the weight of the wall

$$CEF=\frac{\mu_1}{2}\tau\chi^2.$$

Now by similar triangles ∴ *cd* : *de* :: *c*L : EL, or

$$EL=\frac{de\ cL}{cd},$$

but

$$de=P=\tfrac{1}{2}\mu\chi^2\tan.^2\left(\frac{\pi}{4}-\frac{\rho}{2}\right)$$

$$cd=\frac{\mu_1}{2}\tau\chi^2$$

cL = $\frac{1}{3}\chi$, and put EL = y, then

$$y=\tfrac{1}{3}\frac{\mu}{\tau\mu_1}\chi\tan.^2\left(\frac{\pi}{4}-\frac{\phi}{2}\right).$$

Which is the equation to the line of resistance of the wall ECF, if the line CE intersect the base in the point E, as in the diagram, though

$$EL=\tfrac{1}{3}EF=y=\tfrac{1}{3}\frac{\mu}{\tau\mu_1}\chi\tan.^2\left(\frac{\pi}{4}-\frac{\rho}{2}\right)$$

$$=\tfrac{1}{3}\tau\chi \text{ or } \tau=\tan.\left(\frac{\pi}{4}-\frac{\rho}{2}\right)\sqrt{\frac{\mu}{2\mu_1}}\quad \frac{L-\chi}{H}\sqrt{\frac{\mu}{2\mu^2}},$$

whence it follows that if

$$EF=\frac{L-\chi}{H}\sqrt{\frac{\mu}{2\mu_1}}\cdot\chi$$

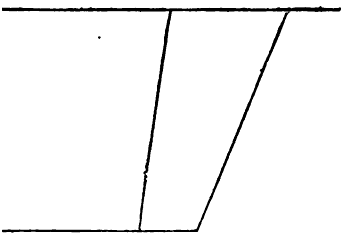
the wall and earth will, mathematically speaking, be in a state of unstable equilibrium.

It would be exceedingly injudicious to build a wall so slightly as the dimensions demonstrated by the above equations,

in absolute practice the line of tance should be made to intersect base within the extrados at some , K, (put EK, as before) $= \frac{t}{n}$. Then system of calculation I pursue is llows:

t BM be the real height of the ınkment, but instead of taking the ure due to this height I calculate the increased height, EC; then if

Fig. 3.



nake the wall ABEE of sufficient nsions to resist the pressure due to that imaginary height, we shall be within the limits of safety. It therefore remains to determine the proper proportion which BC should bear to BF. For that purpose, put $AB = 2EK = \frac{2t}{n}$. Produce EA, and EB till they meet at C, then $\overline{EF} : \overline{FC} :: \overline{AB} : \overline{BC}$ $(= \overline{FC} - \overline{FB})$

$$FC = \frac{\overline{EF}\ \overline{FB}}{\overline{EF} - \overline{AB}} = \frac{n\chi}{n-2} = \chi_1 \text{; suppose.}$$

Now the weight of 1 foot in length of the wall $ABFE = \frac{\mu_1 \chi}{2}\left(t + \frac{2t}{n}\right)$ and because a perpendicular let fall from the centre of gravity would intersect the base, EF, in a point I, when

$$EL = \tfrac{2}{3}\left(\overline{EF} - \frac{\overline{AB}^2}{2(\overline{EF} + \overline{AB})}\right),$$

We have the effective moment of the forces of the wall all round.

$$E = \frac{\mu_1}{2}\chi\left(t + \frac{2t}{n}\right) \tfrac{2}{3}\left(t - \frac{2t}{n(n+2)}\right) = \frac{\mu_1 \chi}{3} t^2 \left\{\frac{n^2 + 2n - 2}{n^2}\right\}$$

h must therefore be equal to the effective force of the prism of earth round ame point $E = \frac{1}{6}\mu\chi\left(\frac{L-\chi}{H}\right)$; whence, writting χ_1, or its equal $\frac{n\chi}{n-2}$ for χ, in to insure stability, we have

$$\frac{\mu_1 \chi}{3} t^2 \left\{\frac{n^2 + 2n - 2}{n^2}\right\} = \tfrac{1}{6}\mu\left(\frac{n\chi}{n-2}\right)^3 \left(\frac{L-\chi}{H}\right)^2.$$

lving this with respect to t

$$t = \chi \cdot \frac{n^2}{n-2} \cdot \left(\frac{L-\chi}{H}\right) \left\{\frac{n\mu}{2\mu_1 (n-2)\{(n+1)^2 - 3\}}\right\}^{\frac{1}{2}} \ldots\ldots (4.)$$

w putting $n = 7$, which is generally found sufficient, then

$$t = x\,\frac{7^2}{7-2} \cdot \frac{L-\chi}{H} \left\{\frac{7\mu}{2\mu_1 (7-2)\{(7+1)^2 - 3\}}\right\}^{\frac{1}{2}}$$

$$= 1.038\chi \cdot \frac{L-\chi}{H} \sqrt{\frac{\mu}{\mu_1}}.$$

m which we may construct the following table:

Slope.	Height.	
1 ver.	½ horiz.	245
1 —	¾ „	·346
1 —	1 „	·43
1 —	1¼ „	·498
1 —	1½ „	·554
1 —	1¾ „	·602
1 —	2 „	.654
1 —	2¼ „	.672
1 —	2½ „	.776

To apply this table for calculating the thickness of the wall at the base:—The nature of slope being given, multiply the height of the wall by the decimal in the table opposite the given slope, and again by the square root of the quotient obtained by dividing the weight of a cubic foot of the soil by a cubic foot of the material of the wall.

Thus, suppose the natural slope of a bank of earth to be 1 vertical to 1½ horizontal, the height of the bank to be retained 30 feet, weight of a cubic foot of earth 90lbs, and ditto of wall 125lbs, then the thickness of the wall at the base $.554 \times 30 \sqrt{\frac{90}{125}} = .554 \times 30 \times .848 = 14.09$ feet, and since $AB = \frac{2t}{n} = \frac{2 \times 14.09}{7} = 4.026$ feet.

In the *Professional Papers of the Corps of Royal Engineers*, vol. viii., p. 78, Mr. C. D. Dempsey observes:

"A practical rule for a section of retaining wall, which has in many cases proved sufficient, and has yet been deemed economical, is as follows:—Let the latter equal one-sixth of the vertical height of the wall, the thickness of the wall at the bottom one-fifth of this height, and the thickness at top one-tenth the height, or one-half the thickness of the bottom, and for the reducing of the thickness divide the entire height into as many equal parts plus one, as there are half bricks in the difference between top and bottom thickness. Thus a wall 30 feet high will batter 5 feet by 6 feet thick at bottom, 3 feet at top, and be divided into nine different thicknesses each 4½ inches less than the lower adjoining one, and each 3 feet 4 inches in height, measured vertically. Under ordinary circumstances, however, economy of material may perhaps be effected, or greater stability be secured, by reducing this thickness, and introducing small counterforts at frequent intervals."

These dimensions are much too slight, and the rule is given without reference to the natural slope of the embankment or the relative specific gravities of the walls and earth.

The base obtained by this rule is even less than is obtained by the formula in Professor Gregory's *Mathematics for Practical Men*, p. 224, where he says, "for walls with an interior slope, or a slope towards the bank, let the base of the slope be $\frac{1}{n}$ of the height, and let s and S, as before, be the specific gravities of the wall and of the earth; then,

$$\text{“DF (the base of the wall)} = h\sqrt{\frac{1}{3n} \times m\frac{s}{S}} - \frac{h}{n}\text{”}$$

The same author also remarks:

"When the earth of the bank or terrace is liable to be much saturated with water, the proportional thicknesses of wall should be at least doubled."

Sir W. Denison, the editor of the *Professional Papers*, in a foot note, remarks on Mr. Dempsey's rule:

"This wall appears very light, a mean thickness of one-fifth of the height, or 6 feet, would be the minimum I should like to trust; and this would give the base 9 feet instead of 6 feet."

Walls are occasionally employed to retain embankments, but viaducts are generally preferable.

The overthrow of a wall may be occasioned by the stones sliding on each other, but so long as the angle, formed by the resultant of the weight of the wall and the pressure of the earth, is greater than the angle at which stones would slide on each other, the wall is quite safe; but if the direction of the pressure forms an angle with the beds less than the angle at which the part would slide the

tion of the wall ensues by push-orward.

ie foundations become saturated ater, the wall may be shoved for-n *masse*. First, because the pres-' the bank behind the wall is in-l, and therefore the angle lessened; condly, because when the founda-are damp the wall will slide on as will a less pressure.

nterforts greatly increase the sta-f retaining walls, and practice and nent show considerable economy g them. The power of resistance wall is shown by multiplying the of the wall by a fraction of the herefore the power will be as the and since counterforts increase the he power of resistance will be in-l proportionably.

form of section (fig. 3) is frequently ved, and is very effectual for the extensor and intrados, throws pendicular from the centre of gra-urther from the point E, and y increases the power of resistance. he foregoing calculations, like all on this subject, the whole struc-considered as one piece, except line when fracture takes place. is reason great care is to be ob-by the contractor in the execution ks of this class; and whether of brickwork or stone, the whole be well bonded throughout, and unterforts (if any are employed) ed into the face wall, and carried he same time with it also; as far sible the whole work should pro-ogether, that the settling, if any, e uniform.

W.

IE EMPLOYMENT OF HEAT AS A IVE POWER.—REPLY OF "x^2" TO H."

—I was aware that my remarks on I.'s" papers were perhaps too con-written, and I now see that they grammatically correct, but I hoped was already conversant with the t, that they were sufficient not s to persuade him that I was right, make myself understood. Upon g over his papers again, however, ot surprised that he did not under-me; as what I before considered ect of an oversight of his, seems to me now to have been the result of error. He says, at p. 404, "If we assume the weight of each particle to be proportional to the 'chemical equivalent' of that substance, (as is so generally done; the chemical equivalent being in fact frequently called the *atomic weight, though after all we have no certainty of this.*") The words now printed in italics I had not before noticed. No! we assuredly have no certainty of it; on the contrary, we are certain that it is *not* the case, except when we are confining ourselves to chemical considerations merely. The term "atom" will have a great deal to answer for, and is a very dangerous word to meddle with. My view of the matter is shortly this—a pound of copper is found to saturate about 3¼ times as much oxygen as a pound of lead does; we therefore say that, chemically speaking, copper contains weight for weight 3¼ times as many atoms as lead does; or in other words, that the weight of an atom of lead is 3¼ times that of an atom of copper. That is to say, when treating of chemistry, we estimate substances according to their chemical powers. In the same way, if bulk were under consideration, we should say that a pound of copper contained one-fifth more atoms than a pound of lead, or in other words, that an atom of lead weighed one-fifth more than an atom of copper. In short, a substance contains a different number of atoms according to different methods of appreciation. I do not mean to say that different bodies are not conceivable as consisting of *real atoms*, or ultimate particles of peculiar size, weight, and shape; but I say that we have as yet made no approaches to the discovery of such peculiarities of atomic structure. No, we can only estimate the comparative number of atoms by the different tests of size, weight, chemical force, capacity for heat, &c., &c., to which tests they do not return similar answers; if they did, then any quantity of a given substance which had the same chemical effects as another would weigh the same, would be of the same volume, would require the same amount of heat to reach the same temperature, and so on. Now capacity for heat may be a new test of the number of atoms, or it may be found to agree with the test by volume as in the case of the simple gases, or with that by chemical power as in the case

of solids and fluids. No doubt, in the problem given by your correspondent, the work done in separating any two atoms is the same in each substance. But what atoms? What are (n) and (m)? To assume at once that they are the number of atoms which the chemical test gives is, I still think, a *petitio principii*. I had, and have again read very attentively the reasons for concluding that $A(r'-r)=B(s'-s)$ on purely mechanical grounds. It seems to me indeed obvious when we have once discovered in the known lengths $n\,(r'-r)$ and $m\,(s'-s)$ what are the values of (m) and (n), and therefore of $(r'-r)$ and $(s'-s)$. After this I need not say that by the word "measure," I meant appreciation generally, and not necessarily by dimension. The sentence, however, which your correspondent quotes is certainly faulty, and I would beg to substitute for it,—"But there is no reason why the number of atoms in the substance should be estimated by its chemical power rather than by its weight or volume." I hope that the meaning of my equations will now be clear. I meant (n), (n_1), and (n_2) to represent the number of atoms in the same quantity of the same body, accordingly as we considered that the ultimate atoms of all bodies were all of the same chemical power, of the same weight, or of the same size. To apply one of the equations I cannot see why, in line 24, col. 1, p. 404, your correspondent might not have written—"Also since in equal weights of the two substances the number of particles is inversely proportional to the specific gravities of the substances, if we assume the volumes to be proportional to the number of particles, (though, after all, we have no certainty of this): then

$$\frac{n}{m}=\frac{\text{Specific gravity of }(m)}{\text{Specific gravity of }(n)}$$

$$\text{Now }\frac{\text{Specific heat of }(m)}{\text{Specific heat of }(n)}=\frac{C'}{C}=\frac{mB\,(s'-s)+W}{nA\,(r'-r)+W}$$

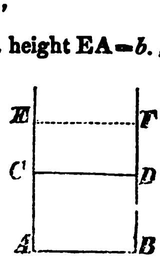
and as W may be made very small, and as it is highly probable that

$$\frac{A}{B}=\frac{s'-s}{r'-r}$$

$$\therefore\ \frac{\text{Specific heat of }(m)}{\text{Specific heat of }(n)}=\frac{m}{n}=\frac{\text{Specific gravity of }(n)}{\text{Specific gravity of }(m)}$$

or *The specific heats are inversely as the specific gravities*."

With regard to my second objection, I must still for the present hold to my opinion. Ph *might*, of course, be made to include the repulsion of the particles; but then it would no longer be the result of observation, but of calculation. My meaning, perhaps, is best shown by an example; and instead of applying heat to dilate the gas, I will do it by mechanical means. I want to find what work it requires to dilate the gas which occupies ABCD under a pressure P, from a height CA $=a$ to a height EA $=b$.; assuming as



the law of repulsion that it varies (as is the case) inversely as the height. Then

$$\text{Work required}=P\,(b-a)-\int_a^b P\frac{a}{x}=P\left(1-\frac{a}{b-a}\log_\epsilon\frac{b}{a}\right)(b-a)$$

where the coefficient of $(b-a)$ is no longer observed, but calculated. I think it, therefore, better to express it at once as I did in the equations which I proposed to substitute. These are,

$$C=Ph-An\,(r'-r)w+NR\,(p'-p)$$
$$C'=Pk-Bm\,(s'-s)w+NR\,(p'-p),$$

when n and m are the number of atoms in equal weights of the two gases, and therefore nw and nw' in the equal volumes.

Now by observation $h=k$, the expansions are therefore equal, and $\therefore n(r'-r)w=m(s'-s)w'$; and by experiment $c=c'$.

$$\therefore A=B.$$

That is to say the atomic repulsions are

equal in all simple gases under the same pressure; a fact which might have been predicted. Also since the increments of molecular distance are in proportion to the repulsions $r' - r = s' - s$.

$$\therefore nw = mw',$$

or the number of atoms in equal volumes of the simple gases is the same.

I have no doubt of the correctness of Messrs. de la Rive and Marcet's results, I merely gave Delaroche's table because I had no other near me. As a general rule, indeed, I confess to great distrust of any experiments, particularly on the specific heat of bodies, without a searching investigation of the method of conducting them. Messrs. de la Rive and Marcet, I am told, are most accurate. I must apologize to you, Mr. Editor, and to "A. H.," for this long and elementary, and perhaps truism-filled letter; but it is better to be tedious than unintelligible. I hope, too, that "A. H." will take my remarks as they are meant; I shall be very willling to find that he is right.

I am, Sir, yours, &c.,

x^2

CLENCHING BOLTS.

Sir,—An article of naval intelligence, from Portsmouth, of the 3rd instant, states that an accident which had happened to the *Melampus* had been occasioned by the bolts which secure the main channels not having been properly *clenched* on the T plates. By this it appears that bolts are still *clenched*.

The imperfection of this mode of securing bolts, induced Sir Samuel Bentham to contrive and recommend, in 1805, the cutting of screws upon the points of copper bolts, with nuts to screw upon them, and metal plates to screw the nuts against, as also others to receive the heads of the bolts.

In his letter to the Secretary of the Admiralty, relative to vessels of war, May, 1813, he gave a short account of this invention, as follows:

"By means of this improvement, the quantity of copper used in bolts might be diminished one-half; and the fastenings at the same time be rendered much more secure than at present.

"The introduction of such screw-pointed bolts, as a *general measure*, I proposed in the year 1805, as also an apparatus for cutting the screws on the bolts, and for forming the heads and nuts; the introduction of which apparatus was sanctioned by the Lords of the Admiralty a short time before I was sent to Russia, and, in consequence, supplied to Deptford Dockyard, where, by means of this apparatus, the screws on the bolts used in the *Fame* were cut; and I have just heard that a ship to be built in Woolwich Dockyard, is ordered to be fastened with screws and nuts, as above described."

In case of shrinkage of the wood held together by bolts, those with screw points afford the further great advantage of being at any time easily tightened, by screwing up the nuts upon them.

B.

TAYLOR'S IMPROVEMENTS IN LOCOMOTIVE ENGINES AND RAILWAY CARRIAGES.

[Patent dated June 3, 1847. Patentee, Mr. George Taylor, of Holbeck, near Leeds. Specification enrolled December 3, 1847.]

The patentee states that his invention consists: *Firstly*, In certain improved arrangements of the steam cylinders of locomotive engines, and the parts which communicate the reciprocating motion of the pistons of the cylinders to the axle or axles of the driving-wheels: which arrangements have for their object to concentrate the driving power of the actuated pistons, so as to communicate an even rotating motion to the driving-wheels, or to distribute the moving power (before concentrating it) in an even and uniform manner to one, two, or more pairs of wheels. The advantages which Mr. Taylor states he believes to result from this part of his invention are, diminished wear and tear of the engine, and the attainment, with safety, of a greater degree of speed, in consequence of the decreased amount of oscillation of the locomotives. The construction is as follows:—Above the boiler, and near the smoke-box, are placed, horizontally and in juxtaposition, two steam cylinders of equal capacity, each having its piston furnished with cross heads sliding in guides supported by the frame of the engine. The pistons are connected by rods to two cranks, which are attached on either side to a wheel having cogs or indentations on its periphery, and which gears into another wheel fastened on the centre of the axle of the driving-wheels. The axle is placed above the boiler, and allows of the employment of driving-wheels of larger diameter (say from 10 to 15 feet), with even a diminished amount of oscillation, in consequence of the weight of the engine being brought near the line of rails.

All the wheels may be made to drive by being coupled in the ordinary manner.

In order that the cog-wheels may work properly and the bearing-springs of the engine act freely, the guides, in which are

supported the journals or axle-boxes of the driving-wheels, are made slanting.

Two modifications of the mode of connecting the piston-rods of the steam cylinders with the axles of the driving-wheels are specified by the patentee. The first consists in forming a slot in the centre of each of the piston-rods, in which works a short vibrating link connected to a vertical frame on either side of the engine, which is made fast underneath the boiler by means of a pin, on which it vibrates;—and in connecting each of these vibrating vertical frames by rods as is usual with the bosses of the driving-wheels; or in attaching one end of a connecting-rod to the outside end of the cross head of the piston-rod, and the other to the boss of the driving-wheel.

Secondly, This invention has reference to the construction of an apparatus applicable to the locomotive, tender and carriages, which serves to retard the progress of the train when necessary, and to support in the case of the breakage of an axle the weight of the carriage. To effect this, two levers are made fast to the bottom of the carriage in such manner as to allow of their acting freely, and have each at the outer end a flanged skid placed directly over the line of rail. These skids have on the under surfaces blocks of hard wood with the grain placed vertically, and are moreover connected by a strong spring. From the centre of this spring rises a vertical shaft consisting of two pieces joined by a threaded connection whereby it can be lengthened or shortened, as required. The top of this shaft is forked, and has between the prongs at top and bottom two anti-friction rollers. Between these rollers is a cam, fastened to a horizontal rod, which is made to rotate by apparatus brought under the controul of the driver or guards, after any ordinary and well-known means. When the longest radius of the cam is brought to bear upon the lower anti-friction roller by means of the rotating of the horizontal shaft, it follows that the vertical shaft is forced downwards and the flanged skids thereby depressed on to the line of rail which they bite, and thus retard the progress of the train. The flanges serve to retain the carriages on the line of rails, and the skids to support the carriage in the case of breakage of an axle; but in order that the vertical shaft may be relieved from the weight of the carriage, stops are inserted in the lower part thereof at the most convenient point, against which the skids catch.

Thirdly, The patentee proposes to divide the tender horizontally into two parts, using the upper or open portion for coals and the lower to contain the water; and to pass the axle of the wheels through the water or *above it*, in order that the weight of the tender, as in the case of the locomotive before described, may be brought nearer the rails.

Fourthly, To employ axles for railway carriages composed of two pieces, one solid and the other tubular, to slide over it; one of a pair of wheels being attached to each piece, so that they may revolve independently of each other.

NOTES AND NOTICES.

Manufacture of Iron Tubes.—Cutler's Patent.—In an action by *scire facias* for the repeal of this patent, tried in the Court of Queen's Bench 1st and 2nd instant, a verdict was found for the patentee. The principal peculiarity in Mr. Cutler's mode of manufacture consists in making the tubes with bevelled and overlapping joints (scarfwise,) instead of the common end to end or butt joint.—See *Mech. Mag.*, vol. xi., p. 45.

New Steam-boat for Canals—A newly constructed steam apparatus, by Christie and Co., of London, is now working upon the Duke of Bridgewater's Canal, between Runcorn and Preston Brook. It consists, first of all, of a simple barge, which carries the engine, but of course has no paddles. It propels itself, with whatever burden is attached to it, by means of a rope, one end of which is made fast at Runcorn, and the other at Preston Brook; there are two barrels fixed in the engine boat, which are made to revolve round their centre pieces by the power of the engine, and, as they go round, they wind up one end of the rope and let out the other, so that, when the barge is at either of the above-mentioned places, one barrel is bare and the other filled with the coil. The rope that is loosed falls, by its own gravity, to the bottom of the canal, so that there is no obstruction offered to other vessels. Thus, when the boat has arrived at Preston Brook, the Runcorn barrel is uncoiled, and *vice versa* on its arrival at Runcorn. On Tuesday last, six loaded barges were attached to it, four of 40 tons burden, and two smaller boats, making altogether 250 tons burden, independent of the steam-boat, which it took to Preston Brook, about five and a half miles, in two hours. It seems fully to answer the expectations of the trustees, and it will enable them to clear the docks of the different carriage-barges at a wonderful rate of dispatch.—*Liverpool Mercury*. [The invention referred to is that of Capt. Beadon, of which a full account was given in our vol. xlv., p. 255.]

WEEKLY LIST OF NEW ENGLISH PATENTS.

Samuel Revington, of Frant, Sussex, M.D., for improvements in dibbling or sowing seed. December 7; six months.

John Scoffern, of Upper Holloway, M.B., for improvements in the manufacture and refining of sugar. December 8; six months.

John Britten, of Birmingham, machinist, for certain improvements in apparatus for cooking, preparing, and containing human food and drinks, and in opening and closing oven doors; parts of which improvements are applicable to other similar purposes. December 8; six months.

James Smith Torrop, of Edinburgh, newspaper proprietor, for improved manhinery for time signals. December 8: six months.

William Dakin, of 1, St. Paul's Churchyard, for improvements in cleaning and roasting coffee, in the apparatus and machinery to be used therein, and also in the apparatus for making infusions and decoctions of coffee. (Being a communication.) December 8; six months.

James Sweetman Eiffe, of 48, Lombard-street, City, for certain improvements in the manufacture of astronomical and other clocks, chronometers, and watches. December 8; six months.

John Hackett, of Leicester, for improvements in

the manufacture of pill-boxes. December 8; six months.

Joseph Clinton Robertson, of 166, Fleet-street, London, C.E., for certain improvements in the preparation and application of colours suitable for printing stuffs composed of silk or wool, or of a mixture of silk and wool. (Being a communication.) December 10; six months.

WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

Date of Registration.	No. in the Register.	Proprietors' Names.	Addresses.	Subjects of Designs.
Dec. 2	1280	Henry John and Donald Nicoll	Regent-street	Hooded cloak.
„	1281	Robertson and Jobson,	Sheffield	Stove grate and hearth plate.
„	1282	John Harrison	Lamb-mill, Cowling, Skipton	Railway chair-pin pressing machine.
3	1283	James Findon	Black Horse-yard, Holborn	Improved water closet and commode joint.
6	1284	Thomas Charles Clarkson	Bennett-street, Blackfriars-rd.	The compressed elastic railway carriage-wagon and truck buffer.
„	1285	George Cole and Ralph Ora	High Holborn	Vapour gas lamp.
„	1286	Freeman Roe	Strand, hydraulic engineer	Spherical valved hydraulic ram.
8	1287	Thomas Powell	Birmingham	Prevenio, or alarm guard against robbery or fire.

Advertisements.

Eratum.—Page 545, col. 1, 4 lines from the bottom, for "The intelligent reader will at once perceive that if the attached at any point N above A," &c., read, "The intelligent reader will at once perceive that if the bar, AE, be attached at any point, N, above A," &c. N is not marked in the diagram (fig. 3, p. 334) to which this refers, but corresponds to the point diagram p. 544.—W. D.

CONTENTS OF THIS NUMBER.

LONDON: Edited, Printed, and Published, by Joseph Clinton Robertson, of No. 166, Fleet-street, in the City of London.—Sold by A. and W. Galignani, Rue Vivienne, Paris; Machin and Co., Dublin; W. C. Campbell and Co., Hamburgh.

Mechanics' Magazine,

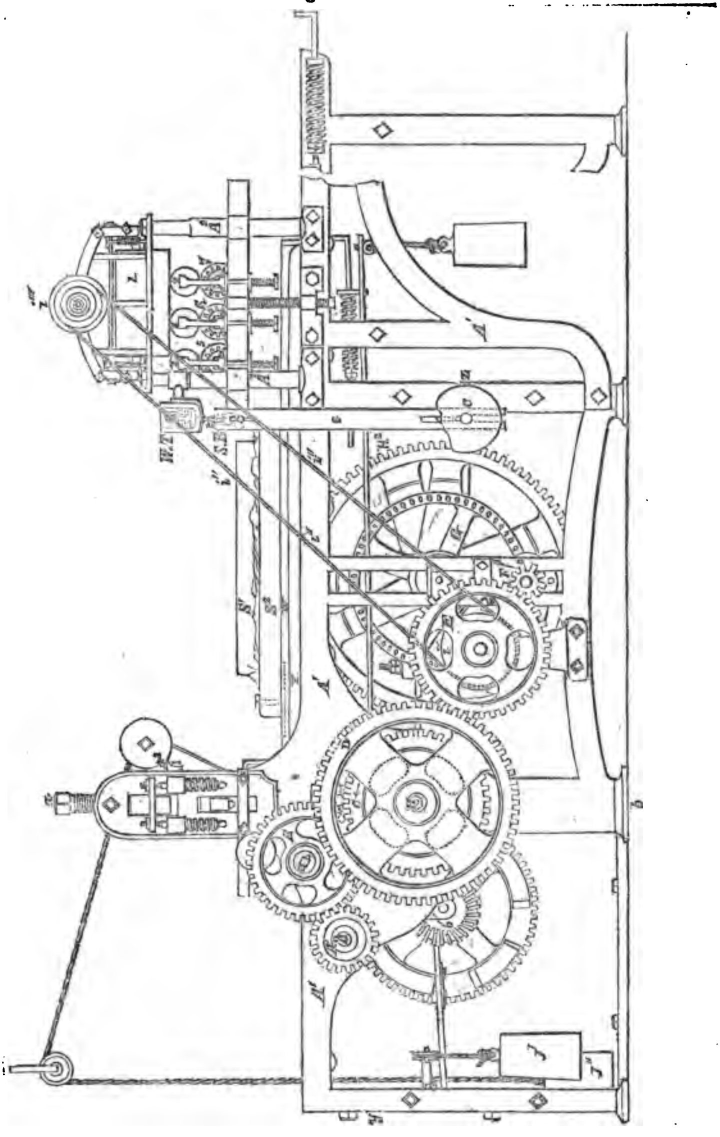
JSEUM, REGISTER, JOURNAL, AND GAZETTE.

. 1271.] SATURDAY, DECEMBER 18. [Price 3*d.*, Stamped, 4*d.*

Edited by J. C. Robertson, 166 Fleet-street.

SMART'S PATENT LITHOGRAPHIC PRINTING-PRESS.

Fig. 1.



SMART'S PATENT LITHOGRAPHIC PRINTING-PRESS.

The improvements by which this lithographic press is distinguished from others, consists in the whole of the press-work, with the exception of the operations of laying-on and taking-off, which are done by hand, as usual, being performed by a series of movements, all resulting from the first motion given to the machine; whereby not only a great saving of labour is effected but a much greater quantity of work is produced in a given time than can be accomplished by the ordinary lithographic presses :

Fig. 1, is a right-hand elevation of this press; fig. 2, is another right-hand elevation with the greater portion of the external parts removed, in order to show more clearly the exterior arrangements of the machine; fig. 3, is a detached view of the roller, M, in fig. 1, and its immediate appendages; fig. 4, is a back elevation on the line, *a b*, with part in section; and fig. 5, is a top plan on the line, *y z*, of fig. 1.

A^1 A^1, is the frame-work of the machine; S^1, is the stone, which is "backed" or connected to a slate-bed, S^2, in the usual way. The bed, S^2, again is bolted to a wooden bed, W, which fits into a cast iron traversing-frame, Y, to the under side of which, at the centre, there is attached a rack, R. A^2, is a secondary framework, mounted on A^1, at one end of the stone, S, which carries the wetting, inking, and cleaning portions of the machine. A^3, is another secondary framework, mounted on A^1, at the other or opposite end of the stone, which carries the tympan and scraper and their appendages. In working the press the stone is placed on the traversing-frame, Y, and moved first towards one end to be wetted and inked, and then back to the centre to have the paper laid on; after which it is moved towards the opposite end to have the requisite pressure brought upon the paper and stone, when it returns to the centre, in order to have the paper, which has now been printed, taken off. And the motive parts of the machinery are so adjusted as to produce successively the exact pauses required for the accomplishment of each of the said operations.

A, is the driving shaft, which gives motion to a series of wheels, B, C, D, E, &c., and may be turned by steam, water, or any other adequate power. A′ and A″, are two pinions attached to the shaft, A, one at each end.

The pinion, A′, takes into a wheel, B, *which works* into another wheel, C, keyed to a shaft, H, which carries a larger wheel, D, which turns a wheel, E, which last turns a pinion, F, which gives motion through the arrangements shown in the plan, fig. 5, (and hereafter explained) to the main-wheel, H″, which takes into the rack, R, of the traversing-frame, Y. The shaft of the wheel, E, also gives motion through the medium of a pulley *i′* and *i″*, to the wheel, *i‴*, of the inking-apparatus, (as also hereafter explained.)

The other pinion, A″, turns a wheel, B″, (see figs. 2 and 3) which takes into a wheel, C, keyed on the shaft of a pressure-roller, M, between which and the scraper, O, the stone is passed in order to receive the required pressure, and so gives motion to the roller in the direction indicated by the arrows.

The pinion, F, which is turned by the wheel, E, is keyed to a spindle (see fig. 5) which is inserted in the cord, *a*, of a forked piece, *a″*, the shaft of which rests at its inner end in a slotted guide-piece, G, and carries a pinion, G′, which takes into a wheel, G″, which is keyed to the same shaft, I, as the main wheel, H″, and thereby gives motion to the same. The wheel, H″, is loosely attached to the shaft, I, in order that it may be put in or out of gear, as required, and this is effected by means of four sets of projecting pins, *p p*, placed at equal distances on one side of the rim of the wheel, which pins drop at each quarter revolution of the wheel into holes, *q q*, in a ring, K′, attached to the shaft, I, at one side of the wheel, H″, producing thereby the same effect as the clutch in ordinary wheel-gearing. The ring, K′, has a feather, by which it may be connected to, or is connected from the shaft, I; and this feather carries at its outer end a flange, K″. J, is a lever centred on the fulcrum, K‴, which is connected by a forked end and spring cord-piece to the flange, K″, of the ring, K′, and is raised or lowered by means of a cam-wheel, I, which derives its motion from a pinion, I′, on the shaft, H, of the wheels C and D, and is kept to its work by a weight, J′. When the feather of the ring K′, is disengaged from the shaft, I, by the ascent of the lever, J, the spring cord-piece of the forked end of the lever being also thereby set free, draws the ring, K, outwards, clear of the wheel, H″, and leaves it free to act on the rack, R, of the transversing frame, Y; but when by the descent of the lever, J, the feather of the ring K′, is interlocked with the shaft, I, the spring cord-piece acts in the reverse direction on the ring, K′, and, pushing it inwards towards the wheel, H″, causes the pins, *p p*, to enter the holes, *q q*,

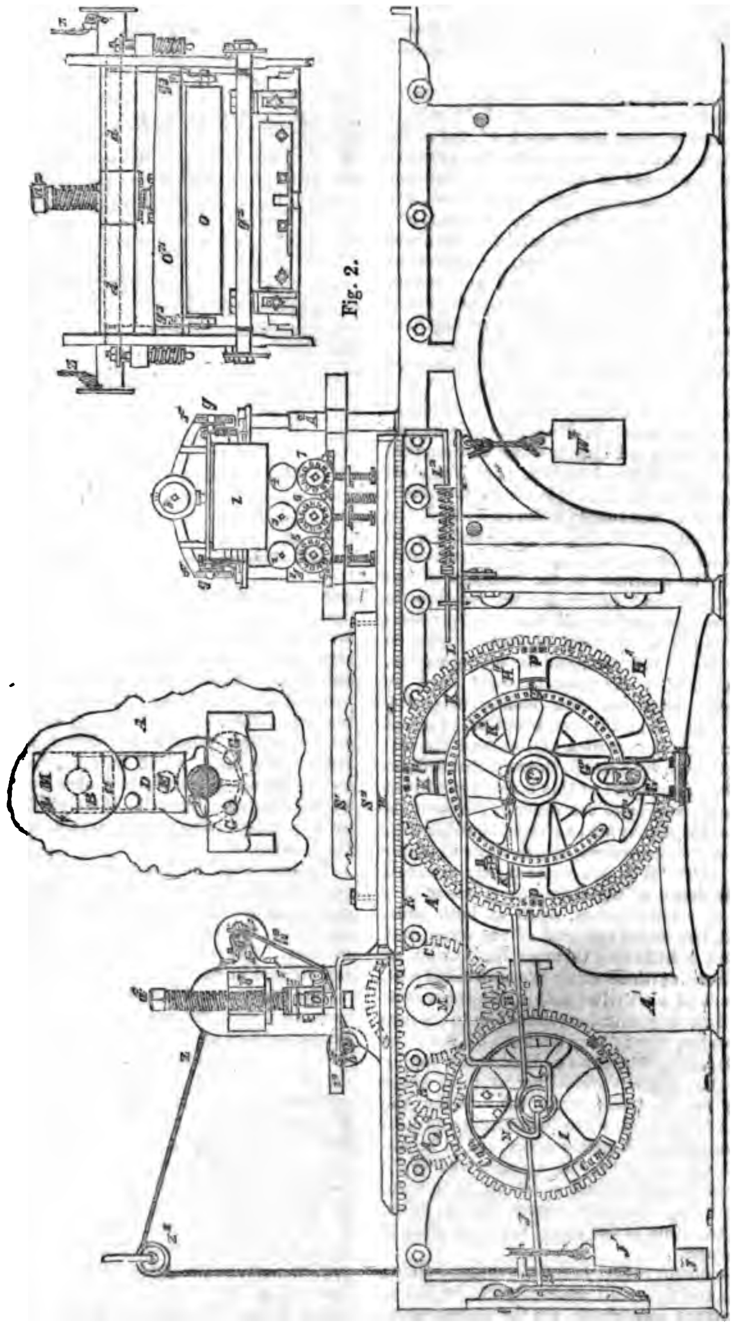


Fig. 2.

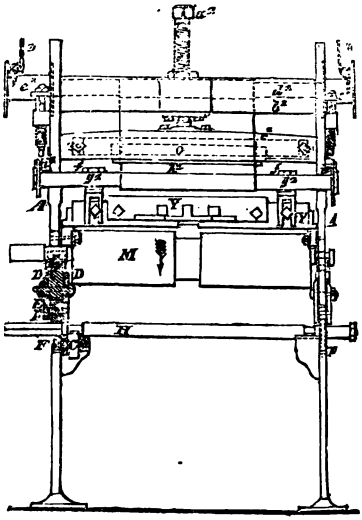
and thereby to interlock the ring and wheel together (in which position it is represented in fig. 5.)

To the shaft of the cam-wheel, I, there is attached at one end a mitre wheel, b^1, which takes into another mitre wheel, b^2, the shaft of which stretches longitudinally towards the opposite side of the machine, and carries at its other extremity a bevil wheel, d^1, which takes into a fourth bevil wheel, d^2, on a cross shaft, *e*, to the end of which cross shaft are attached two cams, *cc*, which, as the bevil wheels revolve, raises and lowers alternately two vertical levers, $e^1 e^2$, which support at top the sponge cleansing box, SB ; as presently hereafter explained.

The apparatus is, as before stated, mounted in the secondary framework, A^2. i''' is a drum, with two endless threads on it (similar to that used in Brown's well-known letter printing machines), which is connected by the band, i'', and pulley, i', to the shaft of the wheel, E. No. 1, is the doctor roller; 2, 3, and 4, the supply rollers ; 5, 6, 7, the inking rollers; and 1^a, 2^a, 3^a, and 4^a, the small distributing rollers. The doctor roller, 1, is attached to the bearings of the drum, i''', and caused by its rotation to move on the surfaces of the supply rollers 3 and 4, in a direction at right angles to their line of rotation; and the inking rollers, 5, 6, and 7, are kept to their work by springs coiled on their respective shafts. The rollers 3 and 6, are supplied by 4 and 7, through the medium of 3^a; and the rollers 2 and 5 by 3 and 6, through the medium of 2^a. The object of this arrangement is to make the supply to the roller 5, the least, in order that it may act as a clearing roller to 3. *gg* are friction rollers, which work in girder bars, *ffff*. WT, is a water trough attached to the front of the machine; *t*, is one of a row of vertical tubes, open at both ends, which rise above the level of the water, and project a little way through the bottom of the trough ; these tubes are each filled with threads of worsted or cotton, the upper ends of which drop over the tops of the tubes into the water, thence they draw up by the force of capillary attraction a continuous supply of water, which they deliver at their lower ends to the sponge-box, SB. When the stone is moved towards the wetting and inking apparatus, it passes under, and in immediate contact with, the sponge, whereby it is wetted and cleaned; but on its return, after being inked, the sponge-box is raised by the action of the cams, *cc*, quite clear of the stone.

The doctor roller, 1, and the supply rollers, 2, 3, and 4, are all made of gutta percha or vulcanized caoutchouc, (in the manner separately represented in fig. 6,) *m*, is the axis, which has a passage, *s*, made through it at

Fig. 4.



one end, which is commanded by a stopcock, *n*; *oo*, are two discs of wood, which are screwed on to the axis, *m*, one near to each end; *p*, is a seamless tube of gutta percha or vulcanized caoutchouc, which is brought at the ends over the discs, *oo*, and made fast thereto by a ring, *q*, and bolts, *rr*. A hollow roller, with a flexible surface, is thus produced, which may be distended to any degree required, and also kept cool by the admission into the interior of water, or any other refrigerating liquid, through the passage, *s*.

Rollers made of brass, as usual, may be constructed in the same manner as the preceding, in so far as regards the provision made for introducing cold water into the interior. (A roller of this description is represented in fig. 7.)

The tympan and scraper, and other parts connected with the pressing or pulling part of the machine are best seen in figs. 2, 3, and 4. A^3, is the secondary framework raised on A^1. a^2, is a regulating screw-rod which works through a cast iron cross head, b^2, and is attached at bottom to the box, c^2, which contains the scraper, o^2, which slides up and down in grooves in the side standards of the framework, so that the position of the scraper, o^2, may be exactly adjusted by the screws, a^2, according to the thickness of the stone and the degree of pressure applied; h^2, is the tympan leather, which is fastened at one end to the rod, g^2, and rolled at the other end round the drum, d^2; *ff*, are clasps which rise from the end of the traversing frame, Y, and lay hold of the

bar, g; $i^2 i^2$, are guides which keep the rod, g, in its place; $e^2 e^2$, are pulleys, or the ends of the shaft of the tympan drum, d^2; and z z, are cards which are carried from the pulleys, e^2e^2, over other pulleys, e^3e^3, and hold suspended from them the weights, J″. When the bar, g, is clipped by the traversing frame, Y, the tympan is unwound from the drum, d^2; while the cords, z z, with the weights, J‴, attached to them keep simultaneously winding on the pulleys, e^2 e^2, and thereby keep the tympans tight during the pull; and when the pull has been made, a reverse action to the preceding takes place, the weights, J″, by their descent causing the clasps, f f, to be liberated from the tympan-rod, g, and the traversing frame to run back towards the centre of the machine. M, is the pressure-roller, before mentioned as acting against the scraper, O. H, (fig. 4,) is the shaft of the wheels, C and D^2, and which of course partakes of their rotary motion. F F, are two cams attached to the ends of this shaft, on which cams the bearing of the pressure-roller, M, rests, being held in the framework by V, fittings, as shown. The edges of these cams work on steel friction-rollers, G G, the ends of which are borne by steel plates, D D, bolted to a cast iron block, B B, with gun-metal bearings, C C.

Instead of a tympan and scraper, such as before described (which are similarly to those ordinarily adopted,) being employed, an arrangement may be substituted, (such as is represented in fig. 8. O, is a roller of gutta percha, or other vulcanized caoutchouc,—which is constructed precisely in the same way as the roller represented in fig. 6, and before described, and runs in bearings in a sliding-box, O^2, attached to the under end of the screw-rod, a^2. It is kept distended to any degree of tightness by water or air admitted through the passage, h, and presents always a flexible, yet firm, surface to the paper and stone. The drum, d, being thus superseded, the cords, z z, are attached to the pulleys fixed on the ends of the axis of the sliding-box, O^2.

L, is a lever which stops the traversing frame when run back by the action of the weights, J″, after the pull has been made. It is raised at one end by a tappet, N, attached to the shaft, H′, of the cam-wheel, I; and has a weight, W^2, suspended from it at the opposite end. L^2, is a spring-rod to which the lever, L, is coupled at its weighted end, to prevent any jar being caused by the stop given to the traversing frame.

The mode of working the machine, the different parts of which have been thus described, is as follows:—The wheel, H″, being clutched by the ring, K′, in manner before explained, and put in gearing with the rack of the traversing frame, Y, and power being applied to the driving shaft, A, motion is thereby communicated through B, C,

Fig. 5.

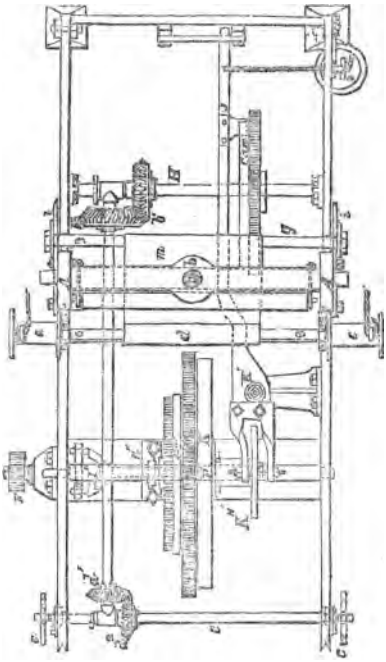


Fig. 7.

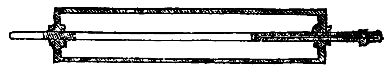
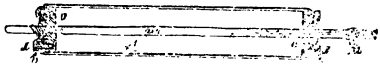


Fig. 6.



D, E, F, and G, to the main wheel, H″; and the traversing frame, Y, with the stone upon it, is passed under the sponge-box and inking rollers. As soon as the stone has been thus wetted and inked, the lever, J, is now brought by the continuing action of the different wheels, and more immediately by the action of the cam-wheel, I, into play, and uncouples the ring, K′, and wheel, H″, which throws H″ out of gearing for the moment with the ratchet-wheel, and this allows of pause enough for the workman in attendance on the machine to lay the paper on the stone. The gradual reaction of the weight, J′, on the lever, J, causes the latter once more to couple the ring K′, with the wheel, H″, and put the latter in gearing

with the rack, R, on which the frame and stone are carried forward under the scraper, O. Immediately on arriving under O, the pressure roller, M, is raised by the action of the cams, FF, and presses up the stone against the scraper, O, for the distance required, while simultaneously therewith the clasps, *ff*, lay hold of the tympan-rod, *g*, which causes the tympan to be removed, and the weights, J″J″, to be raised by means of the cords, *zz*. At the same time that the pressure-roller, M, is thus raised, the ring, K′, and wheel, H″, are once more uncoupled, and the latter disconnected from the rack by the action of the cam wheel, I, and lever, J; and thus they remain during the time the pressure is continued, or, in other words, the pull is being made. The ascent of the cords, *zz*, and descent of the weights, J″J″, then causes the traversing frame to run back towards the centre of the machine, where it is stopped by the raising of the lever, L, by means of the lappet, N, on the shaft of the cam-wheel, I, so as to allow the attendant time to take off the printed sheet of paper.

DESCARTES AT CAMBRIDGE.

The main difficulty of some of the mathematical sciences lies in forming the first broad conception of the principle that runs through them; and the great merit of the first discovery lies in the *method*, rather than in the accumulated details, deductions and applications. Thus, in the geometrical methods of the Greeks, the *form of the argument* constitutes the peculiar character of the method which they employed; and though their analysis and synthesis, and their porisms, are wonderful discoveries, they are all subordinate to the mode of reasoning, and dependent upon it for their very existence. In short, the geometry of Greece is a thing *per se;* and not the slightest approach towards this fundamental conception has been traced, even by the most sanguine admirers of Oriental learning, to an origin independent of those great fathers of all science.

Algebra, on the other hand, is an induction from experiment made upon special numbers; and displayed itself under the form of arithmetical rules for operation—chiefly for commercial purposes—or, often, for the formation of curious puzzles. For scientific purposes it was compelled to lean upon geometry; and amongst the Greeks, the properties of numbers were deduced from the properties of lines. When the names of special groups of numbers had been contracted into abstract symbols, and the names of the simpler operations had undergone the same process, algebra was created as a science. Still it was compelled to repose upon geometry for an intelligible interpretation of the negative sign, and it was only upon that authority (not on any evidence of a self-derived origin,) that it concluded the law of combination of the signs + and − in multiplication and division. There still exist mathematicians who consider those rules to be, even yet, dependent wholly upon induction; and therefore to stand, as regards the structure of the science, in the place of axioms. It has proceeded onward by slow degrees from one induction to another (but still *only* by induction,) till it has grown into the most searching and comprehensive power that the human mind can exercise.

The application of algebra in its early stages was to commercial hypotheses, or to geometrical problems of a determinate kind; and they involved but a single unknown quantity. It is true that at a very early period, and before algebra had taken a distinct and technical form, there were numerous problems proposed and solved in respect to what is called in our books, "Alligation." These are *indeterminate problems*, and for their solution in an algebraic form require two or more unknowns; but we believe that no traces of such an application having been either made or thought of at that period, have been found by the mathematical antiquary. The earliest *distinct* use of two unknowns, and of two equations corresponding thereto, is probably to be found in Cardan's solution of the cubic equation; where the sum of two unknowns is substituted for the one unknown, and a new condition imposed so as to form a new equation—the tendency of the whole being a transformation into a more convenient form for solution. Yet this has more the character of an *expedient* that might possibly answer the purpose, than of a broad principle that would be universally admissible, and be, [illegible],

of incalculable utility in algebraic science. The invention, so far, ended in itself. The principle, however, had been seized and developed before the time of Descartes; and probably the great features of the doctrine of indeterminate equations were fully seen then as they are in our own day.

The honour of the method of coordinates belongs, incontestibly, to Descartes. The great merit of the discovery consists in the primitive conception of the method. Like the feat of the egg of Columbus; it is simple enough—*when we are "shown how."* The single remark, that if parallel ordinates equal to one variable be set off, which are dependent on the value of the other estimated on the line of abscissas, from a point in it, then these ordinates will terminate in a curve of which the given equation is the algebraic representation—this single remark, we say, was quite sufficient to open an interminable vista to the quick and searching eye of Descartes. It opened to him a totally new method of investigating Loci; and in his geometry he attacked the most difficult and elaborate problems by means of his *novum organum*, with the most complete success. In fact, this greatest of all Descartes' works, contains solutions of many problems, upon which no improvements (except, perhaps, mere visual ones, addressed to the eye only, by means of improved algebraical notation) have been made during more than two centuries of ardent cultivation of the general method, by the ablest and most expert analists of that active period. This, like the fundamental principle of demonstration in the Greek geometry, is a thing *per se*.

It is one thing, however, to get at admissible evidence of the truth of a proposition by the use of a mechanical process, and another, to cultivate the reasoning faculties by means of a careful study of the necessary evidence of all the arguments by which the proposition may be proved. It cannot be denied that the Cartesian method is in all strictness a *mechanical method*: it has nothing geometrical about it but the subject matter; and all its processes from beginning to end are those of mere algebra. When the conditions of the problem are written down in symbols, we see nothing more of the geometry till we come to a final equation, which it is the fashion to call "the solution of the problem." If a construction of this equation be attempted, it is *almost invariably* found to be more complex, laborious, and inelegant, than that furnished by purely geometrical analysis; and if the proposition relate to some property of a figure hypothecated, it is often extremely difficult for a mind of average capacity to perceive the manner in which the final equation expresses the enunciated property.

There are other grounds of inferiority besides these of the Cartesian when compared with the Greek geometry. For instance, it is an admitted truth that "we can get no more out of an equation than we put into it;" and yet in our application of the Cartesian Organon, we often *do find* more in our final result than belongs to the problem from whose equations of conditions we originally started. What adds to the perplexity thus created is—that we cannot so assume our data and quesita in symbols, and so conduct the algebraic transformation as to avoid these superabundant results. This has, indeed, been called by some writers, "an advantage belonging to the method, inasmuch as the resulting equation includes all possible varieties of case that can occur in a problem, and thus dispenses with the cumbrous repetitions which render the ancient geometrical treatises so tedious and operose." Were we to grant that this is a fair and honest statement, and, *bonâ fide*, offered as such, we should still have unexplained the perpetually recurring circumstances of the *facteurs étrangères* which arise from the algebraic eliminations that occurred in the series of transformations. These fertile sources of embarrassment are *essential* to the method, for they are essential to the algebraic part of it; and the geometrical problems of any considerable difficulty are few (we had almost said there are *none*) in which the process will not necessarily involve the employment of elimination. We are, moreover, without any direct, simple, and certain means of deciding from the resulting equation whether it

contains these foreign factors or not; and we are thrown back upon the despised *geometrical* consideration of the figure itself, or upon the employment of mere tentative methods of ascertaining whether the indicated results of the investigation *can be true! We must, in short, if we attempt to interpret our results, go back to the old geometry, and to the results which have been obtained solely by means of it.* The Cartesian geometry, therefore, still rests upon the ancient, as much and as completely as did the early algebra for its properties of numbers and its rules for the combinations of signs!

We have said nothing on the intricacies and contradictions which are perpetually presenting themselves respecting conjugate points, the geometrical interpretations of functions of zero, and some other serious *imperfections* in the Cartesian geometry. No comparison can be fairly instituted here between the ancient and modern methods, for this simple reason, that these difficulties do not often occur in discussions which the ancient geometry professes to include within its legitimate range of objects. They peculiarly belong to the objects of the Cartesian; and we refer to it only to remind the cultivators of geometry by this method, that they have a large share of legitimate duty to perform without encroaching upon the Euclidian geometry—even to the extent of *superseding it altogether.*

We see, and see too with much concern, that notwithstanding this utter incapability of algebraic geometry to furnish its own interpretation, there is a wide and general tendency in the Cambridge tutors still further to dissever the Cartesian from the ancient geometry. The eccentric attempt of Legendre to discuss the doctrine of parallels without reference to geometry, and to show that a certain functional equation between abstract symbols, rendered an alleged property of figures in space necessary, has given rise to numberless conundrums of a similar kind. One of them is to build up a course of trigonometry without reference to a single geometrical property of the triangle, or of any geometrical figure! We do not, indeed, *charge the* Cambridge men, to whom we allude, with having been the *inventors* of this extravaganza; for we do not believe either of them to be capable of the guilt of invention. Yet these books (pirated by wholesale as we have, not long ago, shown them to be) carry great weight from the college positions occupied by their compilers; and we cannot sufficiently express our regret and disgust, to see such heterodox views respecting the foundations of mathematical science imposed upon the undergraduates. Nor dare any one of them question the orthodoxy of the doctrine; for he would assuredly be visited by those "pains and penalties" which he well understands, and which would frustrate all his future hopes and prospects in life! He knows what "college and senate-house examinations" mean; and can, at all events, give an intelligible interpretation of *their results* upon his own future career in the world.

To return:—Besides the difficulties attendant upon the occurrence of foreign factors in the result of a Cartesian solution, there are still obstacles in the way of interpretation which the cultivators of that method either overlook or empirically evade. It is by no means true that because the final equation (which we will now suppose to be cleared from all foreign factors) *includes* all possible cases of the relations amongst the data, that "*therefore the problem is solved.*" The specification of the distinct cases is as essential in the new as in the old geometry, in order to effect a complete solution; and in the coordinate method, the expressions, under particular relations of the data, assume very untractable forms, and create great difficulty in deciphering their signification. Sometimes, too, they assume ambiguous forms, which admit of no interpretation at all, without foreign aid from pure geometry, or a new investigation specifically adapted to that case. Under all circumstances the alleged superiority of the modern geometry from the resulting equations containing all the cases of a problem, is a mere superficial fallacy: for the equation, without its interpretation and the separate enumeration of the cases, is *no solution at all.* At the best it can only be considered analogous to the

on of the "general case" of the same ɜm by the ancient methods; and, unily, the solution on the Greek principle be adapted to the special cases with as much facility as the modern one ȝ applied to the same purposes: and, result of much experience in the use th methods, it is our conviction that the solutions have arrived at the stage estion, the specification of cases is easily made in the ancient than in the rn solution. We leave others to judge emselves.

ɜre cannot, however, be instituted the est comparison between the degrees of *ess* with which the signification of the ons by the two methods is apprehended e mind—especially the mind of the ıt. In an educational point of view, s the most momentous form of all which to consider the question. Only om the undergraduates to entertain ague and misty conceptions which ngendered by the slipshod method n fashion of teaching the Cartesian try, and especially inculcate as much npt as possible for the "dull and " geometry of the Greeks, and you will a race of minds for which England will ter have cause to blush. Do we not, inwitness it already? Is Cambridge to be eption to the rule of "gathering figs of s?" Hitherto she has not been; and rank specimens of the gaudy, prickly may be gathered any day in every —the produce of Cambridge thistle-

do not, after all, undervalue the sian geometry. We are not novices employment, nor are we insensible to ue—*in its proper place.* But we are se sensible to its incapacity to meet of the wants of the geometer, and of hysical inquirer too, without the aid ȝ pure geometry of old Euclid. We pecially sensible of its incapacity to r the *logical praxis* to a young mind a course of training to learn to *think.* ıould suppose that the cultivation of of close reasoning and careful research be viewed by considerate men as the great objects of education; certainly, rather than mere dexterity in the use of abstract symbols, and the vague dashes at a supposed generality of mere technical knowledge—about which not one in fifty of the undergraduates cares a straw after he has obtained his degree. It must not be forgotten in connection with this question, that all the splendid eulogies upon mathematics as a gymnasium for the intellect, whether emanating from philosophers, divines, or logicians, were uttered and written at a time *when the Greek geometry was the sole subject understood by the term mathematics*—at a time, too, and amongst a people to whom algebra in all its forms was viewed merely in the light of a curious novelty, and almost as an "occult science." Who has ever bestowed the like applause upon algebra, for the same purpose? Where is the man whose reputation and standing are of the slightest consideration, who will even *dare to do it?* His fame would become like an Irish landlord's life—not worth a day's purchase! Yet because geometry and algebra happen to possess the appellation of "mathematics," the university of Cambridge has imposed the latter subject on its *élèves*, as though it had greater virtues in training the mind than the former—as if mere technicality, and mechanism with abstract symbols, tended more to develop the mind of man than strict logical exercise upon questions where the premises cannot be denied—where the argument is unassailable—and where mere verbiage and play upon symbols are alike excluded. It is really impossible to account for this perversion, except by the assumption that Cambridge tutors generally belong to a class to whom severe thinking is a drudgery, and who consult their own personal convenience by setting their men to *work* instead of training them to *think.* Algebra is good in its place—problem solving is also good in its place; but neither the one nor the other—nor even such applications of algebra to geometry and physics as are made in the text-books most in favour in the university—make a man an accomplished mathematician or a profound thinker. So long, however, as algebraical mathematics

is made the road to honours in the senate-house, so long, in spite of "graces," will this form the one topic of collegiate instruction and the sole object of under-graduate ambition. The moderators are perfectly unshackled as to the questions they shall set, and they are very generally taken in a sort of rotation, not unlike the succession of the aldermen of London to the civic crown; so that there is no guarantee that the papers of one year will resemble in their character those of another year. The under-graduates speculate on the known views of the probable moderator of their degree year, and adapt their measures accordingly. The great business both of the public and private tutors, is to "cram" their men for the senate-house:—not to train them for public life, for the sacred duties of the church, for distinction in the law, for philosophical inquiries, or for intelligent private gentlemen. No; the senate-house *show* is the alpha and omega—the one only object that is of a feather's weight in their estimation.

That distinguished minds may escape from the trammels thus imposed upon them, and recover in after life from the apathy and disgust which three years of such reading creates in most men, we are ready to admit. That men whose minds are naturally so constituted as to create a predilection for such studies, may continue them after taking the degree (especially if they be disposed to marry and are thrown upon private tutorship for an income) we have many evidences before us. When, however, mathematics as a science does not enter into a profession, it is rare indeed to see any man continue the study in any form whatever—and still more to see it in men who have markedly distinguished themselves in the senate-house. Those Cambridge-men who cling to mathematics after taking their degrees, are, generally speaking, men who, by not reading prescribed books, and not taking the subjects in a prescribed order, but rather following their own judgment and inclination, fell low, often very low, on the tripos. We have personally known men of consummate ability and a wide range of knowledge, who stood low on this list; whilst we have known many poor weak-minded things who have walked up to the highest, or nearly the highest, places. The real capacity, knowledge, and power of the candidates is *not tested* by the questions which are usually given in the Senate House; and the position of a man on the tripos is no criterion of anything beyond the amount of "bookwork which he has crammed up," and his dexterity in symbolic manipulation. If any one shall dispute this, let him tell us of what more it is a criterion.

We have dwelt upon this at greater length than we are wont to dwell on such topics; for we consider it an important question, whether the mode of insisting so much, and indeed so entirely, on symbolical mathematics and their applications, which is the educational rage of the present day (we are sorry to say *out* of Cambridge as well as *in* it,) be not an evil in itself and productive of real mischief to the public mind? We wish a dispassionate and disinterested discussion of it: for we have no party purposes to serve—except, indeed, truth and utility be considered party objects.

GRIFFIN'S "TREATISE ON THE DYNAMICS OF A RIGID BODY.*"

The author has very *honestly* given the character of this work in the following Prefatory notice:

"It has been the wish of the compiler of the following work to exhibit *in a brief and compact form* the leading principles of the motion of a rigid body, under an impression that a *syllabus* of this kind is best adapted for the combination of oral teaching and reference to books which is the present practice of the University. While in this view it appears convenient to present the propositions of the subject apart from their applications, it will not be supposed that extensive practice in the solution of problems can be dispensed with by any who would understand the theory of this or any other portion of mechanics. The author has not, however, thought it requisite to include in the present book any specimens of the use of its principles, from an expectation that Mr. Walton's collection will be in the hands of every reader and supply him with guidance and exercise. A few pages of examples have been added as supplementary to those already accessible; and most of them are aimed at particular difficulties and misconceptions to which readers have in experience been found liable, with a belief that questions of this kind are most valuable as a

* A Treatise on the Dynamics of a Rigid Body. By W. N. Griffin, B.D., Fellow of St. John's College, Cambridge, 116 pp., 8vo.: Cambridge, Deighton: London, Parker.

means of starting ...
student is enabled to detect ...
misapprehensions."

We have put one or two phrases of this extract into italics, and we imagine that these few words alone will be sufficient to convey a tolerably correct notion of the book to those who are at all acquainted with the Cambridge system. From the high character Mr. Griffin holds in the University as a private tutor, and the great experience he has had, we were induced almost to hope for a copious and original Treatise on the subject—one which should enter fully into the various intricate questions with which this branch of dynamics abounds, and bring the long experience of the author to bear on the elucidation of difficulties which every beginner encounters, and remove obstacles which each generation of students has had to scramble over in turn. Æneas and his companions were not more in need of guidance through the regions of Tartarus, than is the student entering on the domains of dynamics:—

> "Ibant obscuri solâ sub nocte per umbram.
> Perque domos Ditis vacuas, et inania regna:
> Quale per incertam lunam sub luce malignâ
> Est iter in silvis; ubi cœlum condidit umbra
> Jupiter, et rebus nox abstulit atra colorem."

> "Solitary they wander or lost in the darkness
> Through the empty expressions of Algebra and rows of equations,
> Tumbling and stumbling on thro' a forest of symbols,
> When the author has hidden the meaning behind a dark cloud,
> And the Night of Analysis has taken away from things their usual appearance."

Under these circumstances we offered up the Virgilian prayer:

> "Sit *tibi* fas audita loqui; sit minimè vestro
> Pandere res altâ terrâ et caligine mersas."

As the author however has not chosen this office, all that we have to do is to examine the work as it is. According to the intention expressed in the preface, everything is written in a very condensed way, leaving abundance for the student to do in filling up. In addition to the usual propositions contained in the Cambridge books, the author has introduced some of Poinsot's investigations on Rotation, or rather his *re-*

investigation...
are chiefly the author's ...
portant portion of the subject relating ...
motion of a rapid body about a fixed point, on the simplification of which so many have laboured since the days of Euler, is here treated in a very elegant, though, as usual, *very condensed* manner. Some recent writers on the subject have, in their attempts at simplification, fallen into error, or at any rate made some very questionable and unauthorized assumptions. Mr. Griffin's method avoids these sources of fallacy, and has nevertheless effected a very considerable abridgment of the long processes given in Poisson and Whewell's Treatises. The proof of the equation of *Vis viva* is made to depend, as usual, on that of Virtual Velocities. This method we consider very objectionable for several reasons. In the first place, there is not the slightest reason or necessity for it, as it might be deduced very easily from the equations of motion. In the next place, very few indeed of the students at the University, even of those who are best prepared, ever read any satisfactory proof of the equation of virtual velocities, and therefore, all investigations founded on it must necessarily be destitute of everything like clearness or satisfaction.

About one hundred and thirty problems for exercise are appended to the work, and most of them are original. To a considerable number the answers (not the *solutions*) are annexed. So far the collection is valuable, and it would have been much more so if the *solutions* had been given. Mr. Griffin could not do a greater service to mathematical students than by publishing another collection of mechanical problems with their solutions, similar to that of Walton; and the value of such a work would be still further increased, if it were interspersed with explanatory remarks on the nature of the reasoning and choice of methods to be pursued in different cases.

There are very few men competent to

such a task—and at the same time, there is hardly any work so much needed in mathematical education. There cannot be too many of them when they are well executed. It is with great pleasure that we have seen advertised the publication of Mr. Walton's "Hydrostatical Problems," which we shall take an early opportunity of noticing. Such works as these are of very great value, even to those who, like University students, have access to a private tutor; but to those who have no such advantage, they are worth all other books put together.

It will be evident, from what has been said, that the present work of Mr. Griffin is not at all adapted to any but Cambridge students; and even to them it is presented merely as a "Syllabus." No fault can be found with an author for not producing a kind of work which he did not intend to produce; and so far as the intentions expressed in the preface are concerned, the design is very ably executed, and fully equal to the expectations likely to be formed from the high reputation of the writer. We cannot help repeating, however, what we have often had occasion to say before, that it is a great misfortune to students that they are never to get anything except such cramped condensations. To those readers whose sole object is to cram up for the Senate House it matters little what the text book is, or whether they understand it or not. But to those who really are desirous of obtaining a rational acquaintance with the science, it is a never-ending source of complaint that the books published, are either by incompetent men, or that when a first-rate man does write, it is so often in that condensed and sibylline manner, that his work is fitted only for those who already understand the subject. There are many causes which might be named as productive of this state of things. We think it certain, however, that a first-rate mathematician undertaking to write an elementary work would consult not only his readers benefit, but also his *own reputation* much more, by going fully into the rationale of his subject than by merely putting together a dry syllabus. It is worthy of remark, that by far the greatest authority on the subject of mechanics, who has written an elementary Treatise, namely, Poisson, has also been the most copious in his details. In fact, it is only one who feels his power and ability, who *dares* to trust himself out of the beaten track, and do something more than copy equations. We earnestly hope that such men will learn to see the matter in its true light, and when they do undertake the task (certainly one of great drudgery,) of writing for beginners—write so as to be understood *by beginners.*

ON THE EMPLOYMENT OF HEAT AS A MOTIVE POWER.—REJOINDER BY "A.H." TO "x^2."

Sir,—By your correspondent's second letter, I perceive that his first objection is neither more nor less than an objection to the usually received "Atomic Theory." It can scarcely be considered incumbent on me to enter into any defence of a theory so universally received, and the grounds for which may be found in every chemical work since the days of Dalton. The chemist on analyzing a substance, invariably finds its components in a certain ratio; in oxide of iron for instance, for every 8 lbs. of oxygen he finds 27 lbs. of iron (not to trouble ourselves with fractions.) The numbers 8 and 27 are the chemical *equivalents* of oxygen and iron. So far a mere fact is stated. The *theory* now supposes, as the cause of this fact, that one *atom* of oxygen combines with one *atom* of iron; and that therefore the weight of the iron atom bears to that of the oxygen atom the ratio of 27 to 8. Now here the word "atom," is not by any means intended to imply that the combining particles may not themselves consist of still smaller particles, and those too of different kinds. There is no indefiniteness or liability to error that I can see in the use of the word "atom," as found in the books on chemistry and physics — or if "x^2" thinks there is, it is with the whole mass of chemical and other authors that he must dispute the question. We have, as I said, no *certainty* that *one* particle (or atom) of oxygen combines with *one* particle of iron to form oxide of iron; but such is Dalton's *theory;* and no single fact has ever been brought for-

et in the slightest degree opposed ncompatible with it. That your ondent should bring forward spe- avity, as indicative of an atomic , different from that which would :n by Dalton's theory, has aston- ıe "more than a little." He can- ely have *intended* this assertion. ve nothing on earth to guide us in g even a guess at the relative num- atoms or particles in two bodies ıeir specific gravities; whilst all : want in order to our being per- :ertain as to the relative numbers :icles in equal weights of two sub- (whose chemical constitution is), is simply the assumption that, both combine chemically, each ır particle of one substance com- vith *one* atom or particle of the This assumption is Dalton's c Theory; and your correspondent first person, I should think, who reamt of bringing forward specific ɣ as an objection to it.

h regard to the second objection, ears from the example given by ' that he considers the particles of to have a repulsive influence on other, *altogether independent of* :*at communicated.* He has used 's law, viz., that the pressure of an .ding gas is inversely proportional volume. Now this law requires ıe temperature of the gas should n the same during its expansion. of course can only be done by the ɣ of heat from external sources, (or ; be prevented, then the mercury e thermometer in contact with it give up a portion of its own heat ıll to a lower degree,) and this sup- ' heat must be added to the quanti- ! and C′, if by these quantities we denoted merely the heat supplied .ly by the lamp or other immediate e of heat in the experiment; but ality this amount is the same, for the gases in any one experiment that communicated by surround- bjects, as the atmosphere, &c. The .tion proposed, therefore, would nt simply to taking a quantity from ide of the equation and placing it ıe other with a change of sign. quantities thus introduced are equal e another, because the amount of communicated by the surrounding ts is the same for both gases. "x^2" evidently considers that the expansion is *assisted* by a repulsion of the particles of air or gas; such as, for instance, furnishes the stroke of the piston in expansive engines after the steam is cut off. But he forgets that this assistance is only obtained by the absorption of a certain amount of heat, and that in experiments on specific heat this amount must be added into that which I have denoted by C and C′. If the gaseous particles repelled each other and could produce expansion without requiring any heat, then the connection proposed would be necessary. As it is, however, the work done in expanding gas and mercury is due *solely* to the supply of heat, which I have denoted by C and C′.

I am, Sir, yours, &c.,

A. H.

TREMBLAY'S ETHER-HYDRIC ENGINE.

We extract from the *Moniteur Industriel* the following additional particulars of M. de Tremblay's engine, to which he gives the name of the "Ether-hydric Engine."

The fuel does not act directly on the ether reservoir, but the steam, after having done its work in an ordinary condensing engine, is made to produce a second effect equal to (it is said) the former. It is led in pipes into, and through an ether reservoir, which takes the place of the condenser, and becomes a power-generating medium. The steam traverses the reservoir in several small tubes, becomes condensed, and imparts to the ether the whole of its specific or latent heat. The ether then becomes vapourized by the heat imparted by the steam, passes into a cylinder, and sets its piston working; from whence it goes into a reservoir of cold water, where it becomes condensed, and is forced back to the ether reservoir by a pump. Thus the ether is neither consumed nor dissipated, but alternately passes from a volatalized to a liquid state, and creates power in its passage from one state to the other.

As to the value of the effect produced, it is sufficient to observe, that sulphuric ether boils at 98°, and gives at that low temperature a tension equal to that of water at 213°, and is of equal power.

Supposing M. de Tremblay's invention to succeed, we shall have double the power from a given quantity of fuel, perhaps even more, for the boilers could be fed by the water resulting from the condensed steam, which being distilled, would not be liable to form incrustation in the boilers.

THE ADVANTAGE OF CLEAN HANDS.

Sir,—Permit me to add an interesting fact in connection with the observations of your correspondent, referring to the habits of the workmen in the employment of Messrs. S. Mordan and Co., of the City-road. I was permitted by the courtesy of the proprietors to inspect their manufactory a few weeks since, and learned that the custom to which your correspondent alludes, viz., the refreshing and healthy system of washing by the workmen, enables their employers to realize above four hundred pounds annually, by the sale of the deposit of gold and silver remaining in the water tanks after the men have performed their daily ablutions.

Judging that this evidence of the effects of order and method in a manufactory may be interesting to a large class of your readers,

I remain, your obedient servant,

W. Mattieu Williams.

METALLIC GUNPOWDER CANISTERS.

Sir,—The following short note respecting one of Sir Samuel Bentham's improvements in navel architecture has just been found amongst his papers:

"Moisture is the greatest source of injury to which powder is exposed on board ship; the wooden casks in use for keeping it are little to be depended on as being either air-tight, or water-tight; I therefore, in the year 1795, employed on board the *Arrow* and the *Dart*, sloops of war, metallic tanks, or canisters, closing both air-tight and water-tight, so that the powder within them was preserved perfectly dry.

"These canisters, or tanks, were adapted to the shape of the vessel, whereby a greater quantity of powder was stowed than could be carried in casks: the magazine was so arranged, as that in case of alarm of fire, the canisters could be easily laid under water without wetting or injuring the powder; after danger ceased the whole could be again laid dry."

The late Admiral Raggett, who commanded the *Dart* till he was promoted out of her on having captured the French frigate *La Desirée*, repeatedly spoke of the great convenience afforded by these tanks of keeping cartridges ready filled of different sizes in different tanks.

B.

A SIMPLE TIME-PIECE.

Sir,—The following idea of a simple time-piece has occurred to me, and I think it is original.

Have a flat bar, placed perpendicularly, or nearly so, with teeth regularly cut in both edges exactly corresponding on either side; then a small piece of mechanism with two cog-wheels, the cogs corresponding exactly with the teeth of the bar: the wheel-piece must be heavy and have a well fitting groove, in which the bar is to work. The wheel-piece being placed at the top of the bar (the bar being within the groove) the teeth catch the wheels, and the tendency of the wheel-piece being of course to descend, its downward motion must be regulated by a pendulum, or similar contrivance; the hours, minutes, &c., being marked on the bar. A bar to last for a day might easily be screwed up to the wall of offices, &c. A plan to detach the cog-wheels, in order to push up the wheel-piece at the end of each day, could be easily contrived.

This plan if worth anything, and not before suggested (and I do not think it has) is at your service. I am, Sir, &c.,

J. Murray.

October 18, 1847.

COX'S IMPROVEMENTS IN PRESERVING AND PREPARING WOOD, BRICKS, TILES, ETC.

[Patent dated June 10, 1847. Specification enrolled December 10, 1847.]

We copy the following very circumstantial and complete description of these improvements from the patentee's specification. The great novelty of his process consists, it will be seen, in the introduction of stearine as one of the preservative ingredients:

"My invention consists of a mode or modes of preserving or preparing wood, bricks, tiles, and other substances, by depriving them of moisture, and by impregnating them with bituminous substances, either alone or mixed with other substances in manner hereafter described; the chief object of my said invention being to preserve the substances operated upon from decay or the attacks of insects, or to make such substances more durable, or better adapted for the purposes to which they are intended to be applied. Any description of wood may be subjected to my process, but some hard woods will not be so much benefited thereby as others. Those kinds of wood which are porous, and which are constantly used for many purposes, such as oak, ash, elm, beech, birch, fir, and others, may, for many purposes, be advantageously preserved or prepared according to my invention. The wood which is intended to be preserved, or preserved according to my invention, must first be deprived of its moisture, for which pur-

pose I place it in ovens, chambers, or other apparatus, constructed in such manner that the temperature thereof can be regulated so as to produce any degree of heat which may be required. The heat to which the wood is thus to be subjected must not reach within fifty degrees of the temperature which would begin to char the wood, and such temperature it is well known varies in some degree according to the nature and description of the wood; but the temperature at which charring commences is generally about three hundred degrees of Fahrenheit's thermometer. Unless the wood is very dry before it is subjected to the drying process, the heat applied in the first instance must be much lower than the ultimate temperature to which it is to be exposed, and the heat should in every case be gradually raised to the highest required temperature, at which the wood should be kept until it is thoroughly deprived of its moisture, for the purpose of rendering it fit for the next process or preparation which it has to undergo. And it is to be observed, that the more damp or wet the wood is when it is first subjected to the drying process, the lower must be the temperature to which it is in the first instance exposed. The wood, which is intended to be prepared according to my invention, should not undergo the drying process before described until immediately before it is impregnated as hereafter described, because by exposure to the atmosphere it would very soon imbibe such a quantity of moisture as would prevent it from being properly impregnated. The wood thus prepared is now ready to be impregnated with the melted bituminous substance or substances with which it is intended to be impregnated. The bituminous substances which I employ for this purpose are the residuum remaining after the distillation of gas tar, or pitch, asphalte, or any other bituminous substance which can be liquified by heat, but which remains solid at all ordinary temperatures of the atmosphere. The bituminous substance to be used must, however, be such as will be liquified and remain liquid at a temperature lower than that at which wood would be charred. The bituminous substances used for impregnating or preparing wood, according to my invention, may be mixed with some other substance or substances which may be necessary for causing the wood to possess certain qualities after it has been impregnated or prepared; but the substance or substances so mixed with a bituminous substance must be such as will thoroughly mix or combine with it: and I deem it preferable that the mixture should be such as will remain solid at all ordinary temperatures of the atmosphere. If it is intended to impregnate any of the common soft woods, such as fir, poplar, willow, lime, beech, ash, or elm, so as to render them better fitted to be used in the manufacture of furniture, or for ornamental purposes, I prefer to prepare the substance for impregnating them as follows:—I boil the residuum of gas-tar (which remains after naphtha has been distilled from it, and which is sometimes called English pitch) or other bituminous substance, in a solution of potash, lime, or other alkali or other alkaline earth, for the purpose of neutralizing the acids and taking up the oils with which bituminous substances are generally mixed. If I employ caustic potash or soda, a weak solution will be sufficient; but if lime be used, the solution should be saturated, or nearly so. A solution of one ounce of alkali to a gallon of water will be found of a useful strength; but the quantity of alkali or earth used in the solution must depend on the quantity of acid mixed with the bituminous substance: and the quantity of alkali or earth should be sufficient to neutralize the whole of the acid. The boiling should be continued about two or three hours, during which the melted bitumen and solution should be frequently agitated, so as to secure the action of the solution upon every part of the mass of bituminous substance, after which the solution is to be poured off, or suffered to run out of the vessel in which it has been boiled; and if it be desired to have the bituminous substance very pure, it should be washed with hot water, so as the more effectually to free it from any admixture with the solution, or with any substance which it may have taken up during the process of boiling. This bituminous substance is then to be heated until the whole of the moisture remaining in contact with it has been driven off. To the bituminous substance thus prepared, and in the melted state, I add one per cent. of stearine, and mix them until they are thoroughly incorporated, and impregnate the wood to be operated upon in manner before mentioned and hereafter described. If it be desired that the wood shall be made of a lighter colour than it will possess if the bituminous substance be mixed with only one per cent. of stearine, I increase the proportion of stearine to the extent which may be requisite for producing the desired effect. I also in some cases make wood of a lighter colour by saturating it partially with the bituminous substance, instead of causing it to be completely saturated. I prefer to mix the bituminous substance with stearine in this way rather than with tallow, or any other description of fatty matter, because stearine is harder or firmer,

and not so likely to undergo putrefaction or decomposition. And I would mix the bituminous substance with stearine in every case in which the price of that substance would not preclude the employment of it. This mixture of a bituminous substance with stearine I deem to be of great value for impregnating wood and other substances in the manner described in this specification; and the proportion of stearine might in many cases be increased to one-half with advantage, were it not for the great expense of that article. Bituminous substances may in this way be mixed with resins, gums, gum resins, spermacetti, and other similar substances for the purposes of my invention. Thus, if it be desired that the prepared wood shall be made harder by the substance with which it is impregnated, I mix the bituminous substance with shellac, seedlac, gum sandrac, mastic, copal, resin, or any such substance, as aforesaid, which will produce, or have a tendency to produce that effect. If it be desired that the wood should possess greater elasticity, I mix the bituminous substance which I use for impregnating it with caoutchouc, gutta percha, jintawan, or mineral caoutchouc, or with any of those substances in solution. And when necessary for the purpose of producing the required effect upon the wood to be operated upon, I mix the bituminous substance with two or more of such other substances as aforesaid, which may possess qualities fit for the purpose. When it is desirable to preserve the prepared wood from the ravages of insects, I mix the bituminous substance with which it is to be impregnated with some poisonous substance, such as orpiment, oxide of arsenic, or some of the compounds of arsenic, mercury, or lead, preferring those substances which are most poisonous and least expensive. For this purpose I first melt the bituminous substance in some convenient vessel, and then add to it the poisonous substance or substances with which I may intend it to be mixed, the poisonous substance or substances being first reduced to a fine powder. For the purpose of insuring the effectual incorporation of such powdered poison with the melted bituminous substance, I add the powder gradually through a fine sieve, and whilst I am so doing I keep the melted substance in continual agitation, the agitation being afterwards continued until the materials have been thoroughly incorporated. The quantity of such poisonous substances as aforesaid, which I add to any melted bituminous substance, is about twenty pounds weight to a ton of the melted bituminous substance The quantity may, however, be varied according to the nature of the poison used; thus, if the bi-chloride of mercury be used, the quantity of it mixed with a ton of melted bitumen need not be quite so much as twenty pounds weight. The wood being prepared as before mentioned, is to be impregnated with a bituminous substance, such as before mentioned, either mixed or unmixed with any other substance or substances as before mentioned. This impregnation may be effected either by simply immersing dried wood in the bituminous substance when liquified by heat, or by immersing the dried wood, and also exhausting the air from the vessel containing the wood and the melted bituminous substance. If the wood is to be impregnated by immersion only, I melt the bituminous substance (either mixed with any other substance or substances or not) in a cauldron or other convenient vessel, and I then immerse the wood in a heated state in the melted substance, and keep it so immersed until the wood has been sufficiently impregnated. During the whole of the operation the melted substance must be kept at a temperature sufficiently high to make it perfectly liquid, which, of course, will vary according to the nature and quality of the bituminous substance used; care must, however, be taken not to raise the temperature of the melted bitumen to such a degree as to char the wood when immersed in it. The wood may either be placed in a horizontal or vertical position in the melted substance, as may be deemed most advantageous for facilitating the process; but I am not aware of any advantage which either of those positions possesses over the other for the purpose I have mentioned. The time during which wood must be immersed in the melted substance in order to be sufficiently impregnated, will vary from four to twenty-four hours, according to the nature of the bituminous substance which may be used, and the quality and dimensions of the timber to be impregnated. I believe that wood will be sufficiently impregnated with a bituminous substance, such as I have mentioned, by merely keeping it immersed in the melted substance for a sufficient length of time in manner before described. But the impregnation of wood may be more quickly and perhaps more perfectly effected by exhausting the air from the vessel in which the wood is to be impregnated, or by subjecting the contents of the vessel to a considerable compression, by means of a force-pump, or by the employment of both of those means. For the purpose of enabling the operator to employ exhaustion and compression, or either of those means at pleasure, to facilitate the impregnation of wood, it would be better to obtain a vessel of any suitable and convenient size and

›, which can be made air-tight and be ısted of air, and which is sufficiently g to bear the amount of pressure which ɔe used; and the vessel must be so con- :ed or placed, that the bituminous sub- e to be put into it may be melted there- ' at all events kept melted during the ss of impregnating the timber to be d in it for that purpose. Such a vessel have described having been obtained, 'equisite quantity of bituminous sub- e intended to be used, whether mixed any other substance or not, is to be nto it and melted as before described, g care that sufficient space is left for ıtroduction of the wood intended to be .ted upon. The wood having been and heated, as before described, is then plunged into the melted bituminous ance in the vessel, and the vessel closed made air-tight. If exhaustion is in- d to be used, the air must be exhausted the vessel by means of an air-pump or umps of sufficient power as much as ɜniently may be, and after the vessel 'een kept so exhausted for a short time air may be permitted again to have s to the vessel. This operation may ɔpeated if thought desirable, the bitu- us substance being kept perfectly :d during the whole of the process. ıe exhaustion of the air from the vessel, ir contained amongst the fibres of the l in the vessel will also be exhausted, or n out of it, and the impregnation of rood by the bituminous substance will uch facilitated. If compression be in- :d to be employed, air must be forced the vessel by means of one or more pumps of sufficient power to produce mount of compression which may be ded, and the amount of compression ı is given may be varied at pleasure, ıs may be deemed expedient. The com- :ion should be kept up for a convenient , according to the size and quality of ıiece or pieces of wood operated upon, to force the melted bituminous sub- :e more effectually into or amongst the ; of the wood. Pieces of wood after ; impregnated with any bituminous :ance as before described, are to be ı out of the melted substance, and :d in such a position that the super- s parts of the substances adhering to may run off into some convenient l in which it may be received and pre- :d for use, and if necessary such super- s parts of the substance must be ıed off, or otherwise detached from the l. The wood, when thus prepared, is to :t aside to cool, after which it is ready 'eing used or applied in the manner in- tended. Some porous substances, such as bricks, tiles, or unglazed pottery ware, which are or can be made quite dry, may also be subjected to my process and impregnated with any of the bituminous substances before mentioned in manner before described with respect to the impregnation of wood. Such porous substances must first be thoroughly dried so that all the aqueous particles (which would prevent the impregnation of them by the bituminous substance) may be driven out of them, and they must also be introduced into the melted substance in a heated state. For the purpose of impregnating bricks, tiles, and such porous substances as aforesaid, I employ bituminous substances of the same descriptions as I use for impregnating wood, and either mixed or not with such other substances as aforesaid; the time required for saturating a brick or tile by immersion merely will vary from one hour to two hours. When a bituminous substance is intended to be used for impregnating some hard substances, such as bricks and tiles, which are not liable to be destroyed or injured by insects, it will not be necessary to mix the bituminous matter with any poisonous substances as before described. And if any substance to be operated upon, according to my invention, is intended to be used for such a purpose as will cause it to come in contact with food of any description, the use of poisonous matters would be improper. When any such substances so intended to be operated upon are hard or inflexible, the admixture of any India rubber, gum, or other substance, with the bituminous substance for the purpose of making it elastic will be unnecessary. Bricks and tiles of very inferior qualities may be advantageously prepared according to my invention, and the substances with which they may be thus impregnated will have the effect of rendering them impervious, or nearly so, and greatly preserving them from being injured by frost, and from injury by many other causes. And even unburt bricks and tiles may be impregnated according to my invention if they be first made quite dry, and when so impregnated will be durable. When bricks or tiles prepared by means of my invention are used, the mortar usually employed for building purpose cannot be used beneficially for cementing them, but in lieu thereof a bituminous cement should be used. A bituminous cement for this purpose may be made by mixing (when hot) a quantity of the residuum which remains after the distillation of gas-tar, or other tars, with such a quantity of dry sand or chalk, as will make the cement in the heated state have the consistence of treacle; this cement

must of course be used in a hot state. Pieces of dried peat or turf may be prepared and impregnated according to my invention, in like manner as before described, with respect to the preparation of bricks; and pieces of peat or turf thus prepared may be used for many purposes similar to those for which bricks are used. Having now described the nature of my invention and the manner in which it is to be performed, I hereby declare that I claim as of my invention.

"*Firstly*, The mode of preserving and preparing wood, bricks, tiles, and other substances, by depriving them of moisture and impregnating them with bituminous substances, either mixed or unmixed, with other substances as hereinbefore described; and

"*Secondly*, The mixture of any such bituminous substance as aforesaid, with stearine, for the purpose of impregnating wood and other substances in manner hereinbefore described."

ABSTRACTS OF SPECIFICATIONS OF RECENT ENGLISH PATENTS.

FRANCIS BOWES STEVENS, OF HOBOKEN, HUDSON, NEW JERSEY, ENGINEER, *for improvements in ships and vessels*. Patent dated June 12, 1847; Specification enrolled December 12, 1847.

The patentee remarks that it has been long well known that the resistance which impedes or retards the progress of a vessel through the water proceeds from three causes:—1. The displacement of the water at the bow; 2. The suction at the stern, which arises from the vessel moving from the water; and 3, the friction of the immersed surfaces of the vessel; (no notice being taken of the amount of inertia to be overcome as the vessels referred to are provided with a propelling agent which maintains a continuous momentum.) The two first causes of resistance have been materially diminished by making the length of the vessel greater in proportion to the breadth, and the angles of the bow and stern sharper. The friction of the immersed surfaces has been, however, up to the present time, neglected as constituting but a small element of resistance. And yet it was clearly ascertained by the experiments of the late Colonel Beaufoy, as far back as 1796, that the resistance to the progress of a piece of wood, planed smooth and painted, at a speed varying from two to fifteen miles an hour for each square foot of surface, increases as the squares of the velocities—a result which the patentee states has been fully corroborated by numerous experiments made by the patentee and others on the Delaware and Bariton Canal, New Jersey. In one experiment made with a vessel measuring rather more than 200 feet in length, of 16 feet beam at the water line, and drawing 3 feet with the bows inclining at an angle of 6°, it was found that the resistance due to the friction of the immersed surfaces amounted to three-fourths of the total resistance. The patentee infers, therefore, that the resistance from this source in vessels built long and sharp like the river steamers of the present day, is greater than that resulting from the displacement of water and suction at the stern both together.

The object, then, of the present invention is to diminish the friction by interposing a stratum *of atmospheric air* between the rubbing-surfaces of the vessel and the fluid through which it passes. Several methods whereby this may be effected are suggested; but they all consist in the formation of recesses and irregularities on the immersed surfaces — which it need scarcely be observed is in direct violation of the rule in naval architecture, that the sides and bottom of a vessel should be as smooth and even as possible. The method preferred by Mr. Stevens is as follows:—To the exterior planking of a vessel are attached longitudinally a series of what he terms "scales," which are wedge-shaped pieces of wood of any convenient size overlapping each other, and having the thickest end towards the stern. Ribs of wood, placed at any convenient distance apart, running from stem to stern, are attached to the outside of the immersed surfaces of the vessel, so as to form, together with the scales, a series of cells. In the lower part of each of the recesses formed by these wedge-shaped pieces, is a small pipe, which communicates with a main fixed inside the vessel. The atmospheric air is forced into the main by bellows or fan-blowers, and distributed by means of the pipes in an uniform manner over the immersed surfaces. The patentee states, that by this arrangement the water passes, when the vessel is in motion, from the outside point of the base of the first wedge over the cushion of air forced into the recess on to that of the second wedge, and so on to the end of the series. The cellular construction serves to retain the air beneath the water; but care must be taken that the pressure of the air in the different mains is proportionate to their perpendicular distance from the surface of the water, in order that the air may be distributed through the pipes evenly over the whole of the immersed surfaces.

The patentee states that he also diminishes the suction at the stern by placing there a

number of larger pipes, closer together than at the sides; and further, that the suction in the recesses of a vessel of light draught, is so great (as was proved by experiment) that the atmospheric air is thereby drawn under the bows and distributed over the sides of the vessel.

James Timmins Chance, of Handsworth, Staffordshire, Glass-Manufacturer, *for improvements in the manufacture of glass.* Patent dated June 15, 1847; Specification enrolled December 15, 1847.

The improvements which form the subject of this patent consist, firstly—In annealing sheets or plates of glass, by placing them on a series of shelves one above another. The shelves, which are of thin stone or other suitable material, are supported on iron rafters, which are placed, but not fixed, in a frame in the interior of the kiln, so as to allow of their lateral expansion. This frame is supported on wheels, which run on a second rectangular frame fixed on the top of two vertical shafts screwed on the outside, which pass through and gear into two female screws in the bosses of two wheels, cogged on their peripheries, which are supported in suitable bearings. Between these two wheels is a third vertical shaft carrying on its upper part a cogged wheel, which gears into the two cogged wheels before mentioned. At the lower end of this shaft is another cogged wheel, into which gears a screw keyed on to the end of a horizontal shaft, to which a rotary motion is communicated from a steam engine, or other prime mover. On the horizontal shaft being made to rotate, the centre vertical shaft also of course revolves, and by the gearing before described, causes the two wheels through the bosses of which the two vertical shafts are passed to revolve, and thereby to raise or lower these vertical shafts, and consequently the rectangular frame and series of shelves.

In the front of the kiln are two pairs of doors, superposed with a horizontal space between them, through which issue the flame and smoke from two furnaces, after being reverberated. The doorway is large enough to allow of the series of shelves being run out when necessary. When the fires are first lighted, the series of shelves are lowered to the lowest possible point, and the sheets of glass are passed from the table, which is in front of the kiln, through the horizontal space between the two pairs of doors on to the shelves. As each shelf is filled, the apparatus is progressively raised until the next succeeding shelf is brought on a level with the horizontal opening and bed; and so on to the end of the series. The horizontal opening is then closed, and the glass cooled down.

The patentee states that these details may be varied, but that he prefers the shelves being successively raised to a level with the bed or table, instead of the bed or table being successively raised to a level with the shelves.

Secondly,—The invention relates to melting furnaces in which a plurality of pots are heated. At each end of the general building are two furnaces separated by a bridge, and above them are a series of arches in juxtaposition with spaces between. On each arch are placed two pots, which are conveyed into their proper position through suitable openings in the sides of the building. Above them are the working holes. When the fire is lighted, the openings are closed, and the flame and smoke rising up between the arches, play all round the pots, and issue from the working holes as usual.

Thirdly. The invention consists in mixing the materials for making the glass by a mechanical apparatus, instead of by shovel and hand as heretofore, whereby the mixing is more equal and less costly. The patentee employs for this purpose a chamber with a semicircular bottom, and having an opening at top for throwing in the material, and another at bottom, provided with a door, which is opened when the mixing is completed, and allows it to fall out. In the lower part of the chamber is a cylinder, keyed into a horizontal shaft. On the periphery of the cylinder are fastened, in an oblique direction, several beaters, which, on a rotary motion being communicated to the horizontal shaft, revolve and mix the material very intimately.

William Darling, of Glasgow, Ironmonger, *for improvements in casting and moulding.* Patent dated June 10, 1847; Specification enrolled December 10, 1847.

The improvements embraced in this patent have reference chiefly to railway chairs, and are four in number:

First,—The core for the opening in the chair, into which the rail and the wedge for fixing it are placed, is formed by two wedge-shaped pieces of metal, which, previous to their being inserted into their place in the matrix, are coated, as usual, with black lead. The reason given for forming this metallic core of two wedge-shaped pieces is, that they may be the more easily w[illegible]raw from the matrix when the casting is com pleted.

Second,—The railway chair, after having been cast, is annealed. The patentee say that for this purpose he prefers removin the castings from the matrix as soon as pos sible after the metal has fully set, and at

once depositing them in an annealing oven or sand bath, such as is generally employed for annealing articles cast in iron.

Third,—To facilitate the process of casting railway chairs and other small articles, the patentee employs a revolving table or ring of metal, upon the upper surface of which the boxes containing the matrices or moulds of the articles to be cast are laid. On this table or ring being turned round, which is done by hand, projecting lugs cast upon its outer edge by the moulds, are successively brought opposite to the ladle containing the molten metal, by which arrangement a great deal of time is saved in transporting the ladle from place to place. The circular ring or table rests upon a series of friction-wheels, which turn in bearings supported from the floor of the foundry. The patentee, however, does not confine himself to making the revolving table of a circular form, or giving it a circular motion; for he says it may, with very obvious alterations, be made to travel backward and forward in a straight line, and so bring the moulds into an equally convenient position in regard to the ladle.

Fourth,—The patentee takes the molten iron for casting railway chairs and other articles directly from the smelting furnace, instead of having it remelted, as usual, in a cupulo or other furnace. When the metal begins to come freely down in the smelting furnace, and there is a sufficient quantity in it, the furnace is tapped at such a depth below the surface of the molten mass as to prevent the escape of slag along with the metal into the ladle.

Azulay and Solomons, *for improvements in the manufacture of charcoal and other fuel.* Patent dated June 10, 1847; Specification enrolled December 10, 1847.

To make charcoal, or something at least as good, you are directed to collect the dust and refuse resulting from the manufacture of common charcoal and coke; if not already sufficiently comminuted, you are to crush or grind them to a state of fine powder; you may then add, if you like, some culm, or breeze, or slack, also finely pulverized; and finally, you are to compress the mass by means of an hydraulic press into blocks of about one-eighth the original bulk.

To make a good fire-lighter, take a block or stick of the above compound, dip it in resin, and then cover it over with sawdust, to prevent stickiness.

Both practicable enough processes, but, unfortunately for Messrs. Azulay and Solomons, both old, and much inferior to other well-known processes in extensive use.

Charles Larrard, of Leicester, Machinist, *for improvements in bobbin-cutting machinery.* Patent dated June 8, 1847; Specification enrolled December 8, 1847.

The present improvements have for their object, 1st—The better fixing or steadying of the wood which is to be cut into the bobbin; and 2ndly—The more expeditious cutting of it into the required shape.

1. Mr. Larrard makes use of a fixed point or poppet, for the support of the outer end of the bobbin during the process of being cut; and this support occupies the same place in reference to the bobbin which the back or movable head of a lath does in reference to any article which is being turned thereon. It consists of a small spindle, which is free to turn within the bearings by which it is supported, and is at the same time capable of being readily brought closer to or pushed further from the spindle on the fixed head, so that the wood may be thereby made to rotate or be at rest. The wood to be formed into the bobbin is in the first instance slipped upon the small spindle, when, by means of a lever, the bearing of that spindle is slid forward until it brings the wood up against the catch on the end of the rotating spindle of the fixed head, whereby the wood is made to rotate, and in that condition is ready to be cut into the desired form. The spindle on which the wood was in the first instance placed forms a steady support to the outer end, and prevents any vibration, as well as any splitting and destroying of the wood, while at the same time it supplies the workman with a ready means of fixing the rough piece of wood into the machine, and of easily removing it when finished.

2. The patentee's arrangements for cutting are represented in the annexed figures. Fig. 1, is a side elevation of a rocking frame which is attached by a pin, *a*, to the framework of the machine, and occupies a place immediately underneath that occupied by the bobbin, *b*; *c c'*, are the cutters which are attached to the rocking frame by means of pinching screws, so that they admit of being removed and sharpened when required, and of being so nicely adjusted as to produce the exact form intended to be given to the bobbin. Figs. 2 and 3, are plans of the cutters, *c c'*; *d*, is an eccentric, or cam-wheel, which fills the cleft in the lower part of the rocking frame; the office of this cam is to bring either of the cutters, *c* or *c'*, into action upon the wood to form the bobbin. The cutter, *c'*, which forms the outside of the bobbin, is first brought into action upon the unformed piece of wood by which the outer ends of the bobbin are cut off to their exact form. To prevent the rocking frame

Fig. 1.

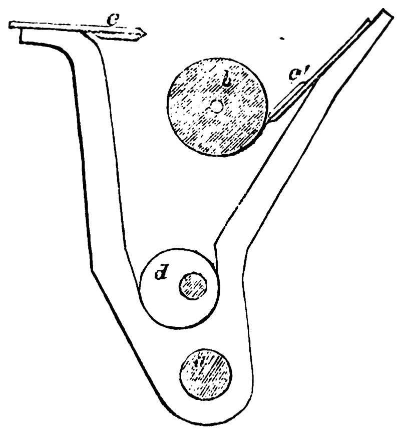
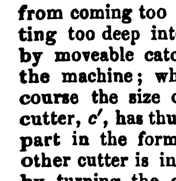
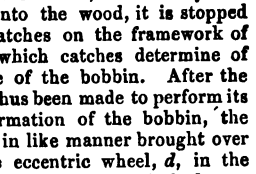


Fig. 2. Fig. 3.





from coming too far over, and thereby cutting too deep into the wood, it is stopped by moveable catches on the framework of the machine; which catches determine of course the size of the bobbin. After the cutter, *c′*, has thus been made to perform its part in the formation of the bobbin, the other cutter is in like manner brought over by turning the eccentric wheel, *d*, in the reverse direction to that which it had previously occupied within the cleft of the rocking frame, which causes the cutter, *c*, to come into action upon the partially formed bobbin, and complete the cutting of it into its proper shape.

It will be observed from the position given to the cutters, *c* and *c′*, upon the rocking frame (fig. 1) that when they are brought to act upon the wood, they meet it at a tangent to the circle of its revolution instead of pointing towards the centre of rotation as the cutting tools of all machines heretofore used for this purpose have done. The patentee considers this an important part of his invention. He describes also some other arrangements in which the cutters, *c* and *c′*, are mounted on separate frames, but the action and the effect produced are exactly similar to that already described.

INQUIRIES AND ANSWERS TO INQUIRIES.

Forging and Welding.—Sir,—If a piece of iron is filed while hot, the filings appear to increase in temperature as they fall to the ground. I am inclined to think that such is the fact, for if a piece of iron be taken welding hot from a forge fire, and subjected to a blast from the mouth, or common house bellows, it may be kept hot, or even wasted by the action of the blast: I have been informed, that nail-makers have a small pair of bellows fixed in front of their anvil, to blow on the iron while working it, to keep it hot. Perhaps some of your readers may be able to tell who first put this plan in practice? It may be worth considering whether nail-making is the only branch of art it can be applied to. As a practical smith, I have an idea that its use might be very greatly extended; for example, the welding of railway-tyres, forging-axles, making cranks, shafts, anchors, &c. &c. At all events, a trial on some heavy work might be made by any one having the opportunity, at a very little, or no expence. I am, &c., VULCAN.

Biddery Ware is the name given to a description of hollow ware manufactured at Biddery, a town about 63 miles N. W. of Hyderabad, in imitation of silver. An alloy is first formed of 16 ozs. of copper, 4 lead, and 2 tin; and to 3 ozs. of this alloy are added 16 ozs. of zinc.

Ice Saw.—"Any information on this subject would at the present moment be very acceptable to your constant reader and obedient servant, *Ascanius.*"—Our correspondent will find in the *Trans. of the Society of Arts*, vol. 45, an account of an ice saw invented by Lieut. J. W. Hood, which seems well deserving his attention. Mr. Hood states that it can be worked by two or four men, whereas the machines ordinarily used by the Greenland whale ships require from twenty to thirty.

Alloys.—"Sir, Will you be pleased to inform me, through your valuable Magazine, what are the component parts of an alloy that will be tenacious when at its common temperature, and extremely brittle when heated to 200 degrees Fah., or less, but will not fuse under 600 degrees? I am, &c., *E. Peters*, Woolwich. Dec. 14, 1847."—The sort of alloy most likely to answer our correspondent's purpose will be obtained by fusing together from 3 to 5 parts of lead with 1 of antimony.

Tool-holders.—"Can you tell me where I can meet with an account of the tool-holder invented by Professor Willis? I have looked in vain for it through your own Journal, and through many others.—*Anvil.*" The "tool-holder" referred to was described in a paper communicated by Mr. Willis to the late lamented Mr. Chas. Holtzapffel, and published in the appendix to the second volume of his "Turning and Mechanical Manipulation." Mr. Willis's holder, however, is stated by him to be an improvement only on one which Mr. Holtzapffel had long had in use; and Mr. Holtzapffel himself observes, in a note to the paper,—"The author believes that tool-holders with small detached cutters were first used in the block machinery at Portsmouth, and since 1830 he has largely employed various kinds of these tool-holders in his manufactory."

The Bronze Medals of the Royal Mint are only bronzed on the surface. The body is of pure copper, which yields a much finer impression than any mixed metal.

Perforated Zinc Plates may be obtained, we believe, with quite as many apertures as the finest wire gauze. We have seen pieces in which as many as 600 holes were inserted in a length of 6 inches; the holes themselves being not more than the six-thousandth of an inch in diameter. "W. H." will obtain full information on the subject by applying to Messrs. Tylór and Pace, Hackney, the successors of M. Lariviere, by whom this branch of manufacture was brought to an extraordinary degree of perfection.

NOTES AND NOTICES.

The "Sarah Sands" Auxiliary Screw Steamer.—Now that this fine ship has completed four voyages to New York, and is laid up for a short overhaul, previous to her next voyage in January, it may be interesting to review the results of her performance. She was built with a view to test the practicability of carrying on the general trade between this country and America, by means of auxiliary steam-power, and judging by the results the experiment seems to have been entirely successful. In first attempts of this kind allowances must always be made for difficulties in the machinery, arising from the novelty of the various parts; and such difficulties, though not of a serious nature, have been experienced in this case. No drawback has, however, appeared in the general principle. It is well known that the New York packets are amongst the finest trading vessels in the world, and a comparison with some of the best of them on the outward voyage, where the greatest difficulties are encountered, will give a good idea of the performance of the *Sarah Sands*.

S. Sands.	Sailed.	Time.	Pkts. passed.	Aver. time.
1st voyage	Jan. 20-47.	20½ days	6	48 days.
2nd ditto	April 6 ,,	23 ,,	6	36½ ,,
3rd ditto	June 15 ,,	34 ,,	6	47 ,,
4th ditto	Sept. 3 ,,	20 ,,	4	32 ,,

A fact connected with the last voyage is interesting. She took out a valuable though light cargo—a large number of passengers, and coals sufficien to work her out and home, with eighty tons to spare, steaming the entire distance, a performance, we believe, wholly without precedent in the annals of steaming. The *Sarah Sands* is an iron ship of 1,000 tons, builders' measurement, and 1,300, new measurement, engines 180 horses power, coupled direct to the screw. She has extensive accommodation for first, second, and third-class passengers, and can stow about 900 tons of goods, besides coals for the voyage. She was built from the plans of Mr. Grantham, engineer, and is commanded by Captain W. C. Thompson, (late of the *Stephen Whitney*,) who superintended her outfit. The *Sarah Sands* returned to Cork with machinery damaged, and lost 14 days, making the voyage 20 days.—*Liverpool Standard.*

Chemical Action arrested by Mechanical Vibration.—A slip of iron, one ¼ of an inch in diameter, was suspended perpendicularly by one end with a strong packthread, and, while so, a vessel of nitric acid was brought underneath it, and then raised so as to allow the lower end of the iron to dip into it. On this being done, energetic action took place, *which was immediately suspended on giving the top end of the slip a smart blow in a perpendicular direction* with a hammer. The iron was then let down in the acid, and remained perfectly inactive during two days. It also communicated inactivity to other pieces that were brought into contact with it. This experiment was subsequently varied, with, if possible, more interesting results. A wire, like the one formerly used, was suspended in the same manner, but the packthread was now held in the hand; it was then struck at the lower end obliquely with a piece of iron, to cause it to ring, and while so, it was introduced into the acid. No action took place on immersion, but the instant the end of the iron came into contact with the side of the vessel, which had the effect of breaking the vibration, action proceeded most energetically, which, on being instantly removed to the centre, partially ceased; then went on, although less partially; but it was quite evident that, as the effects of the vibration became weaker, the action of the acid on the iron increased. Should it be immersed while under the effects of a slight ringing blow, the action is beautifully illustrative of molecular vibration, bubbles of gas being given off the surface of the iron in intermittent waves. Sometimes this is produced in a slip that has been often used, by a smart perpendicular blow at the bottom of the vessel containing the acid. A structural alteration throughout the molecules of iron has been long supposed to take place by some, and ridiculed as fanciful by others. This want of unity of opinion has sufficiently prevailed to prevent the fact from entering into practical consideration with regard to engineering matters.—*Mr. Spencer.*—*Liverpool Mercury.*

WEEKLY LIST OF NEW ENGLISH PATENTS.

David Williams Wire, of 9, St. Swithin's-lane, London, gentleman, for an improved manufacture of candles, and other like articles used for affording light. (Being a communication.) December 15; six months.

Henry Winter, of Uxbridge Gardens, Bark-place, Bayswater, Middlesex, gentleman, for improvements in the manufacture of rope, cord, line, and twine. (Being a communication.) December 15; six months.

George Ambroise Michant, of Epieds, France, but now of New Bond-street, Middlesex, gentleman, for improvements in the production and application of heat, and in the manufacture of coke. December 15; six months.

William Maltby, of Tredegar-square, Mile-end, gentleman, and Thomas Webb, of Mare-street, Hackney, for certain improvements in the manufacture of spirits from grain or other saccharine matters, and in the apparatus to be used therein. December 15; six months.

WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

Date of Registration.	No. in the Register.	Proprietors' Names.	Addresses.	Subjects of Designs.
Dec. 10	1288	Frederick Pedley........	Saville-row, Burlington-gardens	Metallic masticating - plates for artificial teeth.
"	1289	Platt and Son	Chester, chemists to Her Majesty......................................	Medicine measure.
"	1290	Jennens, Bettridge, and Sons	Halkin-street, West London, & Birmingham........................	The Redgrave wine-tray.
11	1291	Parker and Acott	Birmingham	The compound pen and pencil case.
"	1292	John Leary................	Rochdale	Chimney-top.
13	1293	Jonathan Hunt	Kennington Oval....................	Double-acting alarm-whistle for railway carriages.
15	1294	William Dray	Chiswell-street, Finsbury.........	Mud and liquid manure-cart for cleaning streets, cesspools, and other such like receptacles for semi - fluid matters.
16	1995	Henry Sylvester Rogers........................	Salisbury-street, Strand...........	Nurses' assistant, or baby jumper.

Advertisements.

Gutta Percha Company, Patentees,

Wharf-road, City-road, London.

October 1, 1847.

THE GUTTA PERCHA COMPANY, in requesting the attention of the Public to the accompanying Testimonials, have great pleasure in stating that the steadily increasing demand for the PATENT GUTTA PERCHA DRIVING BANDS justifies the utmost confidence that they are fully approved. Their durability and strength, permanent contractility and uniformity of substance—their insusceptibility of injury from contact with Oils, Grease, Acids, Alkalies, or Water, and the facility with which the single joint required can be made in bands of an indefinite length, render them superior for almost all working purposes, and decidedly economical.

Galoshes, Tubing of all sizes, Bougies, Catheters, and other SURGICAL INSTRUMENTS; MOULDINGS FOR PICTURE-FRAMES and other decorative purposes; WHIPS and THONGS, TENNIS, GOLF, and CRICKET BALLS, are in a forward state of manufacture, and will be very shortly ready for sale.

All orders forwarded to the COMPANY'S WORKS, WHARF-ROAD, CITY-ROAD, will receive immediate attention.

Haslingden, September 4, 1847.

Dear Sir,—We have now been using the Gutta Percha Straps for the last eight months, and have great pleasure in saying they have answered our most sanguine expectations; and we may add, that one of our machines which required a 12-inch leather strap, and which almost daily required to be repaired, we have been turning the same with the Gutta Percha Straps 10 inches only for the above-named period, and now find them as good as the day they were first applied.

We remain, yours respectfully,

W. & R. TURNER.

To S. Statham, Esq., Gutta Percha Company.

Atlas Works, Manchester, Sept. 1, 1847.

Sir,—In reply to your inquiry as to the result of our experience with the Gutta Percha Straps, we have great pleasure in stating that the advantages they possess are so very manifest as to induce us to apply them in almost every instance where new straps are required.—We are, Sir, very respectfully,

SHARP, BROTHERS.

Samuel Statham, Esq., Gutta Percha Company.

Bridgewater Foundry, Patricroft, near Manchester, Sept. 3, 1847.

Sir,—In reply to your inquiry respecting how we like your Gutta Percha Machine Straps or Driving Belts, although we have not had quite so much experience in the above-named use of Gutta Percha as we hope to have, so far as we have employed it, it has given us general satisfaction. The beautifully straight and regular manner in which it runs on the pulleys, especially on our cone or speed pulleys, is a strong recommendation in its favour; and although we are inclined to think it does not take so fast a grip on the pulley as leather, yet there is ample hold for all general purposes. We shall continue to use it and to give it our best attention, so as to learn how to employ to best advantage the many excellent qualities it possesses over the ordinary leather belts.

NASMYTH, GASKELL, & CO.

S. Statham, Esq., Gutta Percha Works, London.

Manchester, 18th June, 1847.

Dear Sir,—We beg to inform you that we have now had the patent Gutta Percha Bands or Straps in use for more than six months. For tube frames we consider them very much superior to anything we have tried before. They also do very well as open straps for mules, throstles, looms, &c.

We are, Sir, yours respectfully,

THOS. DODGSHON & NEPHEWS.

Mr. Samuel Statham, Gutta Percha Company.

Wellington Mills, Stockport, 4th September, 1847.

Gentlemen,—We have much pleasure in bearing our testimony to the valuable qualities of the Gutta Percha for driving bands. We have found it answer exceedingly well in most cases where we have tried it, and we think it has only to be made known to ensure its very general use.

We are, Gentlemen, yours obediently,

HOLE, LINGARD, & CRUTTENDEN.

To the Gutta Percha Company, City-road, London.

Tottington Hall, near Bury, Lancashire, September 3, 1847.

Dear Sir,—Your letter of the 31st August is to hand, and in answer respecting the use of your Gutta Percha Bands, I cannot give you a better

CONTENTS OF THIS NUMBER.

LONDON: Edited, Printed, and Published, by Joseph Clinton Robertson, of No. 166, Fleet-street, in the City of London.—Sold by A. and W. Galignani, Rue Vivienne, Paris; Machin and Co., Dublin; W. C. Campbell and Co., Hamburgh.

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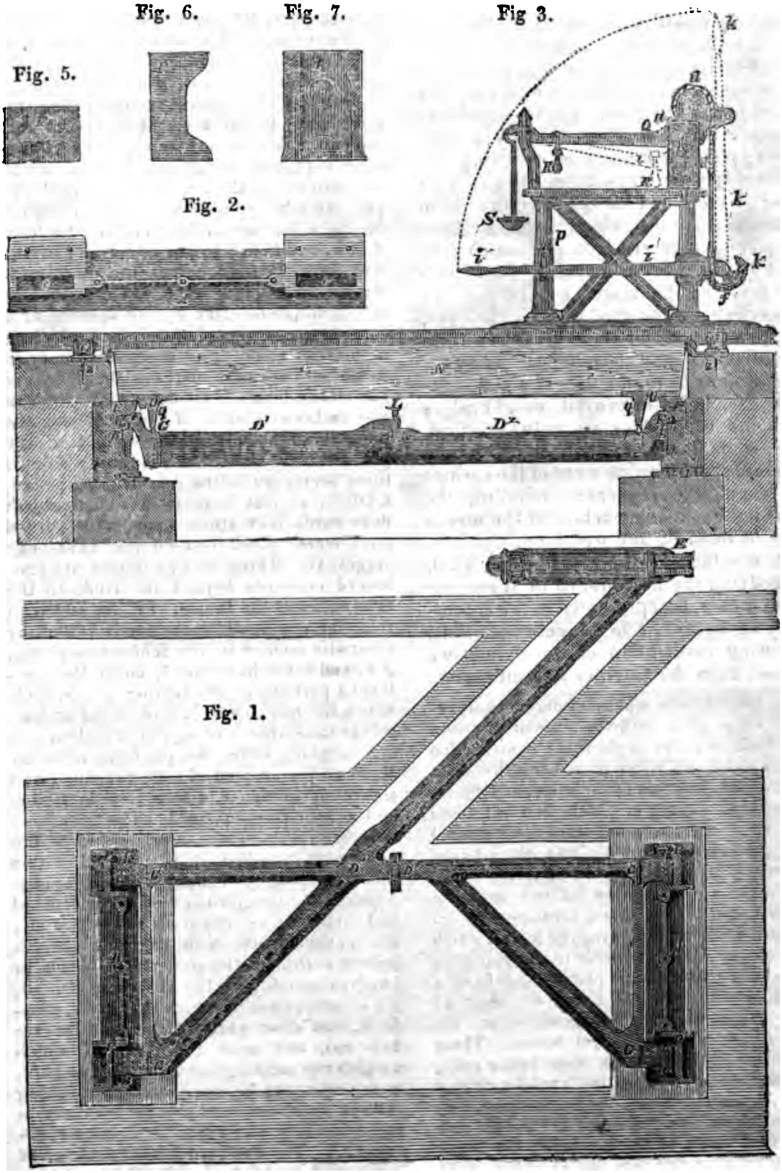
Edited by J. C. Robertson, 166 Fleet-street.

POOLEY'S PATENT IMPROVEMENTS IN WEIGHING MACHINES.



POOLEY'S PATENT IMPROVEMENTS IN WEIGHING MACHINES.

[Patent dated June 16, 1847; Specification enrolled December 16, 1847.]

The improvements embraced in this patent are numerous and important. The object of the patentee may be said to have been twofold; *first*, to produce a greater exactness of performance in weighing machines, more especially those of the larger class, commonly called weighbridges; and, *second*, to give them a more extended application to purposes of trade and business. The improvement in performance is effected chiefly in three ways; 1st, by a mode of relieving the knife-edge bearings from all strain or wear, except when the machine is in actual use for weighing purposes; 2nd, by placing out of sight and touch (except by the person in charge) the adjusting parts of the machine; and 3rd, by protecting, in the case of weighbridges, the pits formed for their reception from the intrusion of wet and dirt. The new applications consist; 1st, of a combination of these improved weighbridges with the turn-tables on railways; 2nd, the adaptation of platform weighing machines to the adjustment of the springs of locomotive engines; and, 3rd, the combination in one machine of the means both of hoisting and weighing.

A machine of the weighbridge kind, embodying the first branch of these improvements, is represented in the accompanying figures, 1 to 15 inclusive. The following description of the details we extract from the patentee's specification:

Fig. 1, of the accompanying drawings represents a top plan, with the table or platform removed, in order to show the construction of the levers and other parts beneath. Fig. 3, is a side elevation of the same, and fig. 4, a transverse elevation. (In the two last views several of the parts are shown in section.) AA, are two foundation plates of cast-iron securely bolted to a level bed of stone, brick, or timber. (A top view of one of these foundation-plates is given separately in fig. 2.) BB, B^1B^1 are four props or fulcra, which rest loosely in slots or sockets, *cc*, made for them in the foundation plates, and have a small extent of lateral action to admit of their accommodating themselves to the movements of the principal levers. These fulcra have steel faces on their upper ends, which in their cross section are of a curved form, upon which faces the knife-edges, FF, of the levers rest. D^1 and D^2 are the two principal levers of the machine; the larger one, D^1, stretches in a diagonal direction from its fulcra, BB, to the point E, where it is connected with the steelyard (figs. 1 and 4.) FF, are the knife-edges by which this lever rests on the fulcra, BB. The shorter lever, D^2, rests by knife edges, FF, on the fulcra, B^1B^1; at its smaller end it terminates in a knife-edge (seen in section, fig. 3,) which rests within a coupling ring, L, by which ring it is connected to the principal lever, D^1, at a projecting point cast thereon. GGGG, are four verges or knife-edge supports, which are inserted in the top surfaces of the levers, D^1D^2, and support the table or platform of the machine. M, is a bar of timber, cut to the form shown, and bolted to the under side of the long lever, D^1, for the purpose of correcting the vibration which would otherwise be caused in the machine by the drawing of a carriage on to the platform, and which is at present a source of much inaccuracy in weighing machines. N, (figs. 3 and 4,) are two strong beams of timber (or made of iron and timber combined, if preferred) for the purpose of sustaining the weight of the platform and load. To the under side of these beams are bolted four bearing pieces, COCO, of cast iron, from which project downwards four studs, *gggg*, with curved steel faces, which rest on the knife-edge verges, G. These bearing pieces are prolonged outwards beyond the studs to the extremities of the beams. PP, are cast-iron receiving props, which are firmly bolted, or otherwise secured to the foundation plates, AA, and come immediately under the prolonged portions of the bearing pieces, CO. When the machine is in a dormant or quiescent state, that is to say, ungeared, or not in a weighing state, the platform rests on these props. A plan of these props is given separately in fig. 5, a side view in fig. 6, and a front view in fig. 7. The balance or steelyard part of the machine, with the framework to which it is attached, forms the upper portion of the side elevation, (fig. 3;) Q, is the steelyard, which is constructed and suspended as afterwards described. R, the movable poise, with its hanger, which indicates the fractional parts of a ton or hundred weight, as the case may be. S, the counterpoise, by which the levers, platform, and other parts of the machine are balanced, and upon the plate of which weights representing tons or hundred weights, as the case may be, are placed in weighing (except in those machines which have a supplementary steelyard, as hereafter described.) The steelyard is shown, detached

from its frame, and on an enlarged scale, in figs. 8 to 13, both inclusive; fig. 8 being a side elevation of it; fig. 9, a longitudinal vertical section; fig. 10, a horizontal section; fig. 11, a top view of it; and figs. 12 and 13, transverse sections on the lines *ab* and *cd*. It will be seen, from an inspection of these figures, that the body of the steelyard is hollow, and has concealed within it an adjusting weight or bar, T, which is

Fig. 4.

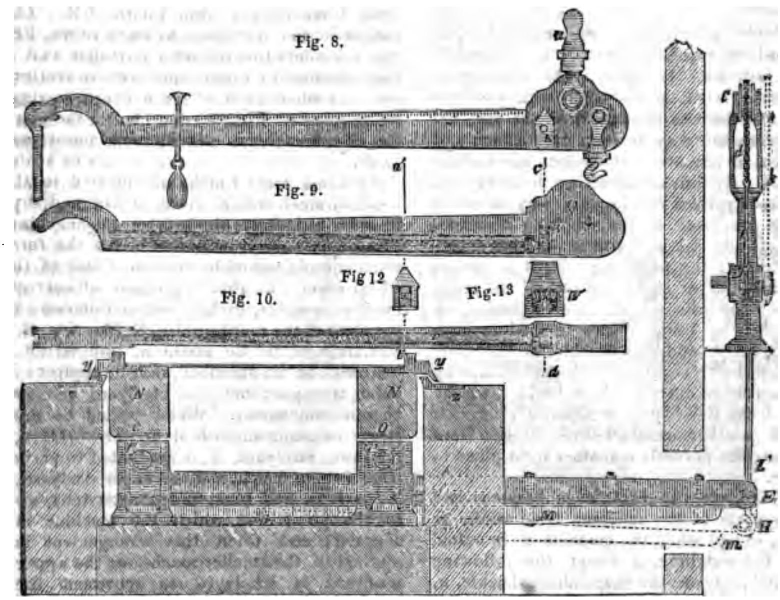


Fig. 11.

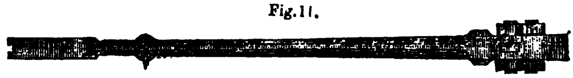
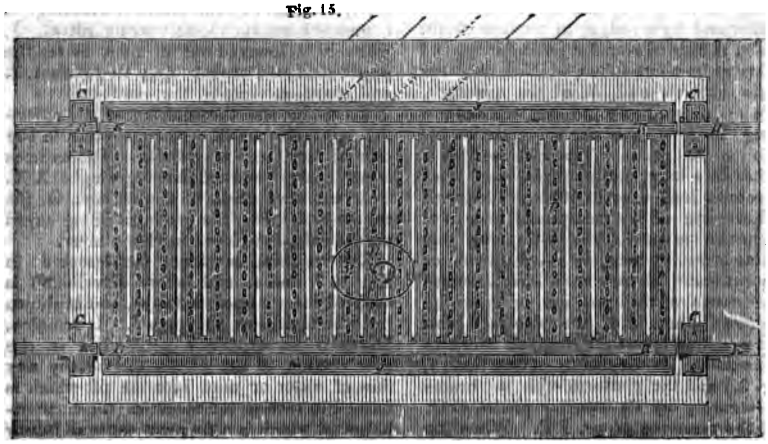


Fig. 15.



movable to and fro in its recess by means of a screwed rod, U^1. The screwed rod, U^1, carries at one end, V, a pinion with diagonal teeth, into which gears an endless screw or worm, W, the axis of which is fixed at right angles to the screwed rod, and, pass-

ing through the sides of the steelyard, is filed off flush therewith. A hole, K, is made in each side of the steelyard, opposite to each end of the axis, by inserting a key into which the worm, W, may be turned round, and the adjusting weight, T, made by means of the screwed rod, U, either to advance towards or recede from the point of the steelyard, according as the state of equilibrium of the machine may from time to time require. If desired, the key may be dispensed with, and a head, with a milled edge, be fixed to the worm, or the internal adjusting bar may be moved by a rack and pinion, or any other equivalent mechanical means. By thus constructing the steelyard, the most perfect equilibrium may be at all times preserved in the weighing machine. without any risk of disturbance from external causes; the adjusting weight is placed not only out of sight, but out of the reach of persons who might, from curiosity, or mischief, or fraud, desire to meddle with the balance; and it is capable, at the same time, of being regulated with perfect ease by the person in charge. It is, besides, wholly free from liability to accidental alteration which in other machines often occurs from moving the portable machines from place to place.

To relieve the knife-edge bearings and other parts of the machine from strain or wear, except when the machine is in actual use for weighing, I adopt the following method:—Over the suspending shackle, *a*, (figs. 3 and 8) of the steelyard, is placed a pulley, *b*, (fig. 3,) which turns freely on its axis, *c*. To this suspending shackle is riveted the first link of a chain, *d d*, which passes over the pulley and is connected at its other end by a rod, *e*, to another chain, *f*, which is carried round a quadrant, *g*, and terminates in a screw-bolt which is inserted into the extreme end, *h*, of the quadrant, where it is secured by a nut, the screwed end serving to give the exact regulation of length to the chain. The quadrant, *g*, is attached to a long and powerful hand-lever of wrought iron, *i*, or in other words forms the short arm of the compound lever, *i g*. The action is as follows:—Suppose the machine is out of gear, or in a dormant or quiescent state, the long hand lever assumes in that case a vertical position, as shown by the dotted lines, *k k*, the steelyard and main weighing levers are dropped down to the positions, (shown also by dotted lines, *l*, in fig. 3,) and the platform with its beams rests securely by its bearing pieces, O O, upon the receiving props, P P. When the machine is required to be put into a weighing state, the long hand lever, *i*, is drawn down from the vertical to the horizontal position, that is from *k*, *h*, *i*, (fig. 3,) and made fast in the strong catch or staple, *n*, which is bolted to the pillar, *p*. The effect of this is to raise the steelyard, the weighing levers, and the platform, to the precise points for weighing.

When the weight is ascertained, the hand-lever, *i*, is released from its catch, and returned to the vertical position, *k*; when all the parts of the machine fall again into their former quiescent and safe position; all the knife-edge bearings and other parts being released from contact, and safe from the effects of loads passing over the platform.

In some cases I make use of a supplementary steelyard, X (as shown in fig. 14,) in order to indicate the heavier weights, and thus obviate the trouble and loss of time so often complained of in the case of machines which require weights, representing tons or hundred weights, to be lifted and placed on the plate of the counterpoise, S, (fig. 3.) In this arrangement the means of internal adjustment, before described, may be applied to either the upper or lower steelyard as may be most convenient. When applied to the larger weighing machines, or weighbridges, the lower steelyard, Y, is graduated to parts from 1 lb. to 5 cwt., and the upper steelyard, X, to tons, half tons, and quarter tons, up to the power for which the machine is adapted; and when this arrangement is applied to the smaller machines, the upper steelyard is employed to represent the hundredweights, and the lower steelyard pounds or ounces.

When the relieving apparatus is to be fixed to machines having the supplementary steelyard, (fig. 14,) the compound leverage is connected to the lower steelyard, which, when it is lowered out of gear, leaves the upper steelyard at rest upon its fulcrum, *t*, and guard, *s*.

To render also the working of the relieving apparatus a still easier operation in the case of very large weighbridges, I sometimes attach a large counterbalancing weight, X X, by a common chain to a quadrant, Q, (as shown in fig. 14,) the quadrant being keyed on the axis, *z*, of the long hand lever.

The weighing machine, (represented in figs. 1, 3, and 4, and before described,) is adapted for use upon railways, and is shown in these figures as so applied. It remains, however, to explain a peculiarity in the construction of the platform, whereby any flow of water or mud into the pit which is formed to receive the machine (the accumulation of which is a frequent cause of injury to such machines, and of inaccuracy in their indications) is wholly prevented, and which improvement is equally applicable to the

platforms of weighbridges or turntables, wherever placed.

With this view I make the kirbs, *z z*, of cast iron, and in the form shown in the section in figs. 3 and 4, the inner edges being turned up angularly as a flanch. Over the top of the kirb so formed, the moulded edge, *y*, of the platform is brought as seen in section, in fig. 4. It is obvious that this shape of kirb and platform will turn off any water that may fall upon them, whilst the mproved relieving apparatus, before deicribed, by raising the platform from its quiescent position, will free the edge of the platform from contact with pebbles, or other matters which might otherwise affect the accuracy of the results. A plan of the platform as fixed, is given separately in fig. 15; R R, are the rails; C C, chairs; P, the platform; and M H is a man-hole, to give access to the pit, for the purpose of cleaning or repair.

I have described my improved steelyard and relieving apparatus as connected with a weighbridge, with rectangular platform, and as adapted to a railway, but I wish it to be understood that I do not confine myself to that particular shape or application, but that

Fig. 17.

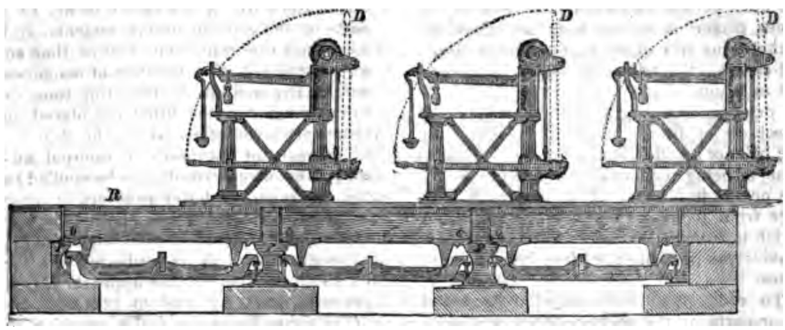
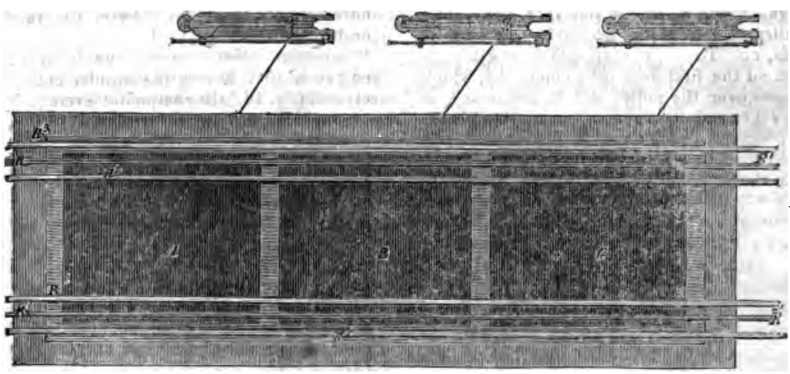


Fig. 16.



the platform may be circular, hexagonal, or of any other convenient shape, and the machine be adapted as well to common roads as railways.

The enclosing of the adjusting weight or bar in the body of the steelyard is an adroit and ingenious contrivance; the new form given to the kirbs of the platform, is also a most obvious and useful improvement, but the most striking feature of all is, undoubtedly, the knife-edge relieving apparatus. Many attempts have been before made to protect the knife-edges when out of work, but none which could boast of such decided success as this. The mode hitherto commonly employed for this purpose has been to place underneath the platform,

a system of machinery composed of cams or eccentric wheels, pinions, levers, &c., by which the dead weight of the machine might be raised off the knife-edges; but such machinery, besides being complicated and liable to derangement, requires both considerable time and labour in working. Mr. Pooley's machine is wholly free from these objections. He avails himself, as the reader will perceive, of the power of the principal weighing lever, D^1, for the purpose of effecting the desired relief; combined certainly with other relieving levers, but which contribute only in a very inferior degree to the end in view. We make no doubt, that by this means the machine may be raised with nearly equal ease and celerity into a weighing position, whether it is empty or loaded.

We are not unmindful, that in the class of weighing machines made according to Mr. Fairbank's patent, the knife-edges are relieved by means of a single lever, which is placed above the head of the machine, and lowers the platform down to a stationary bed, or bearing; but this is an arrangement which is applicable only to the smaller description of weighing machines, and is wholly unsuited to large machines of the weighbridge class.

The reader will, of course, understand, that though the patentee has contented himself with describing how his improvements are applied to the weighbridge class of machines, they are equally applicable to machines of all sizes; to such, for example, as are used in warehouses, wharfs, and shops, and whether they are stationary or moveable; making always such modifications in point of dimensions and arrangement as differences of circumstances may obviously require.

Of the *new applications*, the 1st has been already disposed of, by the preceding description—namely, the combination of these improved weighing machines with the turntables on railways. The details of their application to the adjustment of the springs of locomotive engines, which forms the 2nd application, are represented in figs. 16 and 17, and thus described.

Fig. 16, is a plan of a set of weighing tables or platforms, A, B, C, with a principal line or pair of rails, $R^1 R^1$, passing over them, and two other parallel lines or pairs of rails $R^2 R^2$, and $R^3 R^3$. Each of these tables or platforms is connected with a steelyard, of the improved construction before described, with its frame and relieving levers, (as shown in the longitudinal section, fig. 17.) Now, supposing these tables to be in a dormant or quiescent state,—that is to say, with the long hand-levers in the vertical position indicated by the dotted lines, D D D, and the platforms with their beams resting by their bearings, O O, on the props, P P P P; then let a locomotive engine be brought upon the machine along the rails, R R, till each pair of its wheels rests upon one of the tables; when the engine is so placed, let the long hand levers, D D D, be brought down to the horizontal position, which will bring all the parts of the machine into a weighing state. The steelyards will then indicate, first, the gross weight of the engine, and second, the weight imposed on the rails by the leading, the driving, and the following wheels, respectively; and also, of course, the state of the springs by which the engine-frame is supported upon the axles: should any of the pairs of wheels appear to be unduly loaded, the bolts by which the springs are made tight or slack may be screwed or unscrewed, until in the judgment of the engineer the driving wheels have their proper impact, and each of the other pairs of wheels bears a suitable proportion thereto. But it may, and does often, occur that one of the springs of a pair of wheels may not be properly adjusted, although the entire weight indicated as borne by the pair of wheels is accurate; I therefore test the wheels separately, in manner following:—The engine is first drawn on the machine along the rails, $R^2 R^2$, by which the three wheels on one side only of the engine are brought upon the tables, the wheels of the opposite side being upon the permanent way. The indicated weight of each of these three wheels is noted, after which the engine is drawn off to convenient points or switches, and again brought upon the tables along the rails, $R^3 R^3$, whereby the weight of the wheels on the opposite side of the engine is ascertained in like manner. The two sets of results are then compared, and any disparity corrected by screwing or unscrewing the springs, until a perfect adjustment is effected.

A very simple way this is, of correcting a very frequent source of irregularity in the action of locomotive engines, and one which is we apprehend but too generally overlooked. Engines would never jump so often as they do were they as equally balanced as they ought to be.

The combined machine and weighing

machine (3rd new application) is represented in fig. 17 to 22 inclusive:

Fig. 18 is a side elevation, partly in section, and fig. 19 a top plan of a weighing crane adapted to the above purposes. In its general form it resembles a crane of an ordinary kind; and the wheel and barrel, pinion-shafts, and other hoisting-parts, may be of any approved construction, ac-

Fig. 20.

Fig. 17.

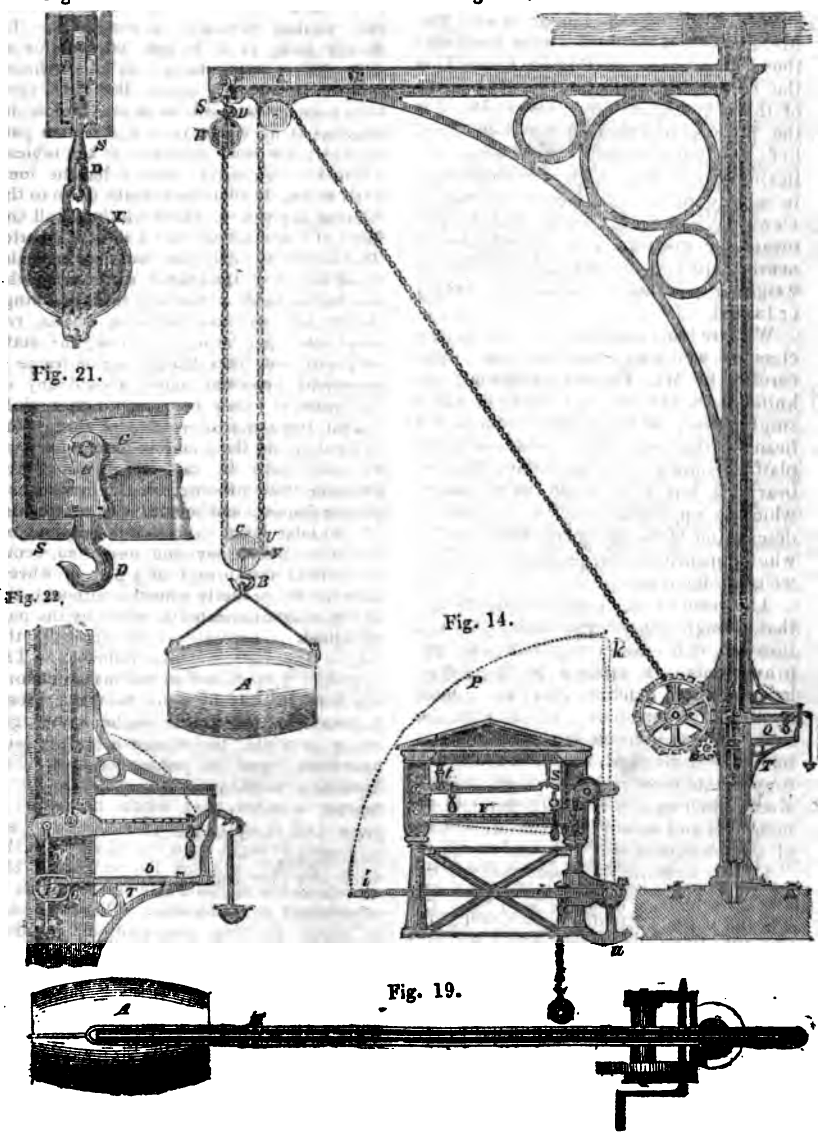


Fig. 21.

Fig. 22.

Fig. 14.

Fig. 19.

cording to the power required in the crane, or to the weight which it is intended to lift.

A, represents a load hanging to the crane by a hook, B, and live pulley, C. Round

this pulley, C, the chain passes, and has its last link attached to the peculiarly formed bearing hook, D, (which is shown separately in an enlarged scale in figs. 20 and 21—fig. 20 being a front, and fig. 21 a side view.) The upper portion, E, forms a double shackle, the holes in which have their surfaces of hardened and polished steel. The hook is hung by these holes upon the knife-edge centres, F, of the long lever, G. This lever, G, is shown as placed between the sides of a double jib, by which sides it is hid from view; but the lever may be placed over or under a common or single jib, in which case it would then be exposed to view. The fulcrum of the lever, G, is at H, and may be either rigid or suspended in a link, as may be most convenient. The longer end of the lever is prolonged to the centre of the pillar of the crane at I, where it terminates in knife-edge centres. From I is a connecting rod, K, which descends to the steelyard at L, to which it is connected by a shackle and knife-edge centres. The steelyard itself, so far as regards construction and adjustment, is similar to those before described—except, only, that it is a lever of the second order, having its fulcrum at the extremity of the shorter end, and instead of a suspended link sustaining the fulcrum, that fulcrum forms part of a rod, M, which descends below the steelyard, and passes through a guide or eye, N, in which it is at liberty to move freely, so as to admit of a small extent of oscillating motion in the steelyard, in order to prevent any friction from rigidity. The disengaging fulcrum rod, M, is shown in detail in fig. 22. It has a frame, O, within which is fixed an eccentric wheel, P, having its axis connected by proper centres with the pillar of the crane. Upon the axis of the eccentric is keyed a hand lever, Q, the design of which is to relieve the centres and all other parts of the weighing machinery from strain or wear during the time of hoisting, and at all other times, except when in the act of weighing. The manner in which this effect is produced is as follows:—When the crane is used for hoisting only, the hand lever, Q, is in the vertical position indicated by the dotted lines, R, and the shorter end of the steelyard and the long lever are raised to the extent of the eccentric action, and the square bearing shoulders of the bearing hook and shackle, D, are brought down to the stationary resting bed upon the jib, S. In this state, the weighing apparatus is entirely quiescent, and the crane is merely an ordinary hoisting machine. When a load is lifted by the crane, which it is desired to weigh, the hand lever, R, is drawn down to the horizontal position at Q, and made fast to a staple or catch fixed to the bracket, T; by this movement the hand lever acting by its eccentric wheel upon the steelyard and long lever, raises the bearing hook and shackle from its bed, and puts all the parts of the apparatus into a weighing state. As the length of chain between the bearing hook and shackle, D, and the body, A, to be weighed, is liable to considerable variation, it will be necessary in order to accurate results that the weight should be ascertained when the load to be weighed is at one given height from the ground. For this purpose I make an indicating link, U, in the chain, which is very obvious to the view, and which link on its arriving opposite to the indicator, V, fixed upon the axis of the live pulley, C, marks the altitude at which the load may be accurately tested. Upon the chain immediately under the hook and shackle, D, is a large hollow ball of cast iron, W, having a cased passage through its centre (vertically) to admit the chains, and being perforated by a screwed hole on its upper side, X, through which hole lead, either in a melted state or in the form of shot, is to be poured into the chamber for the purpose of counterbalancing the dead weight of the parts composing the weighing apparatus; or the requisite counterbalance may be attached to the long lever if preferred, or provided for in any other suitable way. After the crane has been first fixed, all subsequent corrections of the balance may be effected by the internal steeelyard adjustment before described.

We look upon this as being an exceedingly useful machine. In many cases a great deal of time may be saved by being thus able to lift and weigh at one operation; and in other cases it will furnish a convenient means of weighing bodies, which in consequence of their great bulk and awkward form it would be difficult, if not impracticable, to place upon any platform weighing machine.

Bank Notes.—A paper-manufacturer of Massachussets has made some important improvements in bank-notes, with a view to the detection of forgery. The invention consists in introducing into the body of the paper cotton threads, whose number show the value of the note; thus, under "five dollars," the notes contain one, two, three, four, or five threads; six dollars, six threads; seven for twenty; eight for fifty, nine for one hundred, ten for five hundred, and eleven for one thousand. There will thus always be an indelible sign to guide one in the value of the note, however the letters and figures may have been altered. Several banks in New York and the East are making preparations for the adoption of this paper. and it is expected its use will become general.—*United States Courier.*

GASKIN'S SOLUTIONS OF GEOMETRICAL PROBLEMS.*

There is one remarkable feature by which nearly all the Cambridge text-books and syllabusses are strongly marked: a total want of all reference to the *history* of mathematical science. Even if in any particular case, a reference to some problem that has been previously and amply discussed, should be made, the manner in which it is made proves undeniably, that it is taken not at second-hand, but at twentieth-hand. Whatever is given in these books is almost invariably given in such a form that the reader is left under the impression of the writer of the book being the real author of all that it contains. We shall have occasion, presently, to apply these remarks, and to show the tendencies of all those systems of education which do not in some degree include the history of the mathematical and physical sciences.

In the article "Descartes at Cambridge," inserted in our last week's Number, the writer had in view to show one important defect, and the consequences which ensue from it, in the present academic system of mathematical tuition. He had before him not only Mr. Gaskin's solutions of the geometrical problems of St. John's, but likewise a very able work written by another Cambridge man, Mr. G. W. Hearn, Professor of Mathematics in the Royal Military College. Want of space alone prevented the reviewer from giving, as a pendent to his own remarks, a paragraph from Mr. Hearn's book;† but the omission may here be supplied. It must be noted that Mr. Hearn is an ardent advocate for what he calls "the *supremacy* of analytical mathematics;" and it must be confessed, that as far as his *argument* (rather than his *conclusion*) extends, he has acquitted himself with great skill:

"The fact is, that for several years past it has been the custom for incipient graduates, after having passed the senate-house examination with more or less credit, to take pupils. Now those tutors (many of them highly estimable men, and men of sterling talent,) are often very inexperienced, probably most of them thoroughly ignorant of mathematics only three years previous to entering on their tutorial occupations. But education, like every thing else, requires study, thought, and experience. A young tutor may be a highly talented individual, and yet a very bad teacher. He has forgotten the difficulties experienced by himself, and perhaps never known those experienced by others. He cannot believe it possible that any being born with reasoning faculties can stumble in going over the Pons Asinorum, or fail to understand the Binomial Theorem, and a thousand other minutiæ. He therefore takes too much for granted as to the state of knowledge of his pupil; and all pupils are anxious to conceal rather than display ignorance.

"The tutor, therefore, taking it for granted that his pupil is already possessed of the appropriate preliminary ideas, ushers him too rapidly into the domains of analysis. The pupil appears to progress rapidly, feels perfectly satisfied both with himself and his tutor, and soon begins to fancy that he *may be* Senior Wrangler. He can solve any quadratic, separate roots, draw tangents and assymptotes, differentiate and integrate like harlequin, and all this after having read only three terms. But he cannot do the simplest deduction from Euclid, has no idea of a geometrical limit, makes sad bungling of a statical problem, and does not understand Taylor's Theorem.

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* Solutions of Geometrical Problems, consisting chiefly of Examples in Plane Co-ordinate Geometry, proposed at St. John's College, Cambridge, from Dec. 1830, to Dec. 1846: with an Appendix containing several general properties of Curves of the second order, and the determination of the magnitude and position of the axis of the conic section represented by the general equation of the second degree. By Thomas Gaskin, M.A., late Fellow and Tutor of Jesus College. Cambridge, Deighton; London, Parker; 1847.

† "Researches on Curves of the Second Order." London: Bell. 1846. This work is less known than its great merit deserves. It is addressed, however, only to those who already possess a fair degree of acquaintance with the co-ordinate methods. We should add, that Mr. Hearn was sixth wrangler of his year; and therefore, we should think, that even at Cambridge he would be admitted as a competent authority on its modes of tuition. We hear it, however, continually made a matter of complaint by non-resident university men, that the resident members of the senate "systematically put them aside by a lot of petty manœuvres." These "manœuvres," we fear, are not confined to mere matters of academic government, but to the infinitely more important one of advancing the cause of science. Mr. Hearn's book is unappreciated and unknown in his university; and Mr. Gaskin is the only author who has even alluded to it—which, however, he does honestly and honourably. Mr. Hearn is *non-resident*—and that is enough!

"This state of things continuing, he is ushered into Dynamics, Lunar and Planetary Theories, &c. &c., and becomes ready for the Tripos, from which he emerges last of the Senior Ops, retires from Cambridge, and is puzzled all his life long to find out what is the use of a University education.

"Had such a youth been in the hands of an experienced person and distinguished mathematician, who would have taken care to *educate* him properly, who would have carefully *completed the links* connecting geometrical and algebraical reasoning, who would in every analytical investigation have kept the ideas appropriate to the subject of investigation constantly before the mind of the pupil, who would have shown him in many cases the identity of analytical and geometrical reasoning, and that in all cases the former is as it were the sublimation of the latter; then indeed it would not have been

"'Parturiunt montes, nascitur ridiculus mus.'"

We have so recently noticed Mr. Gaskin's Solutions of the Trigonometrical Papers of St. John's, and the opinion of the author's skill as a "problem-solver," which we then expressed, is so completely borne out in this new work, that we can only designate it as a superior one *of its kind*. In fact, the one work is strictly a continuation of the other, and the composition of the two is so strictly in due keeping, that whatever is said of the one *must be* said of the other—with however, a single, but important exception.

Trigonometry is, properly speaking, not only one of the *legitimate* applications of algebra (or generalised arithmetic) to geometry, but in the natural as well as the historic order of the development of the mathematical sciences, it is the *first* application. As may be expected, it will also very frequently supply *brief* methods of establishing geometrical properties, and of solving geometrical problems; and though we are not disposed to look favourably on the method when used to supersede the ancient geometry, we have not the slightest objection to its use for either deducing or resolving, when professedly used as a trigonometrical *praxis*, or in illustration of the relation between the pure and the mixed geometries. We, therefore, in the most full and cordial manner expressed our entire approbation of Mr. Gaskin's former work.

The present work, however, stands in a different position; which we will explain. The papers given at St. John's, which he has here selected, are the professed papers on *geometry*, and not on the *geometry of co-ordinates*. These are the papers which contain *all* that is proposed in connection with the ancient geometry, or even in connection with the *géométrie supérieur* in that college. We should, therefore, have anticipated that the resources of the ancient, and especially of the *modern* continental geometry, would have been very prominently brought into effective operation amongst these solutions. A better opportunity could not have been desired—could not have been created. Mr. Gaskin, however, instead of moving with the times, and availing himself of researches ready to his hand, goes back to the Cartesian organon, and throws the whole weight of his influence into a support of "the supremacy of analytical mathematics!" Does Mr. Gaskin really mean to imply that the ancient geometry in its pure form, and the researches of Monge and Carnot, and their illustrious disciples, Poncelet, Ollivier, and Chasles (the greatest of them all,) for instance—are so utterly unworthy of all Cambridge regard as to be alike "swamped" in the "vortices" of the Cartesian whirlpool? It is, indeed, a "maelstrom;" and all other modes of treating geometry than this one have little other academic prospect than that of the unfortunate mariner who ventured within the "suctional area" of that awful gulph, the descriptions of which so often made us shudder in our juvenile but adventurous days.

There is one very marked difference between the ancient and the Cartesian geometry in "the manner of setting about the solution." It is this—that whilst the Cartesian forms at once his equations expressive of the conditions of the problem or the hypothesis of a theorem, the geometer proceeds by successive and consecutive steps from one property to another till he at

length arrives at the truth, or the construction, which he is investigating. The Cartesian of recent times has in a great degree abandoned this great feature of his method, and condescended (without acknowledgment, however,) to copy the processes of the antient geometry; and instead of his vaulting at once to his final solution, like the bird of Jove to his eyrie, he creeps along from one stepping-stone to another with a consciousness that his pinions are shorn, and powerless for flight. Those who have most successfully cultivated the Cartesian geometry have most closely copied the manner of procedure which distinguishes the ancient; nor is Mr. Gaskin an exception to this rule.

No doubt he has made the best he could of his subject; but the defects in the method itself could not be eradicated even by him. This is no reproach; neither is it intended to throw a shadow of doubt upon his full possession of the high "analytical power" which is universally conceded to him in Cambridge. We have read with great care a considerable number of his solutions, and we have met with few instances where we could suggest any material improvement. This, at least, will not be considered the confession of hostility or intolerance. Still it is remarkable that Mr. Gaskin nowhere even hints at the necessity of interpreting the final result—at least we have not found an instance. He simply forms the equations implied in the question, gets out the stated result, and then considers the solution finished. It is against this negligence of a *principle*—against a habit which Cambridge studies inevitably engender—that we raise our voice. A better book than Mr. Gaskin's, on the principle he has adopted, could not we think be produced by any man living: but we want more, much more, than this.

As these "geometrical problems" are solved on the same plan as the "trigonometrical," we may assume that he has "adopted the method which the nature of each example suggested, in preference to the employment of analytical artifices, by which many of the results might have been obtained more concisely." We do not, however, we must avow, understand why there exists the least necessity for Mr. Gaskin to confine himself, in a printed book which is to be studied at leisure, to the cramping necessities which the limited time of an examination in the Senate-house may impose upon the under-graduates at that particular juncture. We should certainly have considered that a publication such as this afforded a very favourable opportunity for rendering those "analytical artifices" intelligible to the men; and that a most desirable occasion had occurred for enforcing attention to the signification of the results and the evidence of the steps by which those results were obtained. These read in private by the under-graduates would have been beneficial in every sense—infinitely more so than ten times as many solutions "written out," even though given in the able, and often adroit, manner of Mr. Gaskin. Men might have been led to *think* as well as taught to *work* at the same time.

Mr. Gaskin states that these questions "have been proposed by some of the most distinguished members of the Society [of St. John's]; and that the generality of the results are remarkable for their neatness and simplicity." Now, to the term "proposed," if we are to understand "invented," we most emphatically demur. We have met with a very small number of questions amongst this list that have not been perfectly familiar to us for many years—and most of them long before the period at which these papers commence. We will add more—that we discover traces of even the *Diaries*, as well as the "Transactions of learned Societies," having been consulted to form this series, as well as many other college and Senate-house papers. Now, it is somewhat ungracious for Cambridge men, when they know that more than two-thirds of the questions in every paper have not the shadow of a claim to originality, to hold up the questions so selected as being of Cambridge origin. The many elegant theorems and problems respecting lines of the second order, which are included amongst these

Johnian papers, are, so to say, "as old as the hills;" and those remarkable ones in Mr. Gaskin's second Appendix are more familiarly known to the French and German geometers than the Elements of Euclid are to the great majority of Cambridge men. Such assumption of originality in these and other such problems bespeaks either great disingenuousness or great ignorance of mathematical literature beyond that of the University itself. We confidently believe that the latter cause is the true one as regards Cambridge men in general; though, possibly, to a small section, the first explanation will more properly apply. The men, as we have urged in the early part of this review, are not trained to look into the *history of science:* they hence spend their time in the invention of problems and the discovery of theorems in a bit-by-bit and desultory manner, and are rewarded by turning up now and then a few of those curious relics which to a well-read mathematician are mere "mare's nests" whilst, as the old phrase runs, the discoverer "stands chuckling over the eggs." We cannot express how much and how deeply we have been disgusted to witness such scenes.

We have a case in point before us. One of the questions in the series, No. 4, is this;—"To inscribe in a circle a triangle whose sides, or sides produced, shall pass through three given points in the same plane." Mr. Gaskin's discovery that it was not one of those invented by "a most distinguished member" of St. John's College, originated in a remark made by Mr. Hearn ("Curves of the Second Order," p. 15); and Mr. Hearn's own knowledge of the subject is deduced from Montucla, or more probably from his superficial and supercilious editor, Lalande. Yet our readers have only to turn to Potts's "Appendix" to learn how many other writers have treated on this problem and its generalisations; whilst these Cambridge authors are satisfied to print their own researches without examining whether any one of all those many authors had anticipated them in method and result! Able men do injustice to themselves as well as to others by this procedure. How stands the case here? Mr. Hearn was entirely anticipated as to the *method* pursued nearly forty years by Gergonne, Servois, and Rochat —who also extended the method to the conic sections: whilst Mr. Gaskin was anticipated in his *construction* by Lhuilier before the close of the last century. We believe, however, that Mr. Gaskin in his method of investigation stands alone; and a most effective and elegant method it is—a perfect master-piece in its way. It is a full and effective answer to the half-challenge with which Ottajano concludes his paper on the geometrical solution of the same problem.

It appears that after Mr. Gaskin's work was printed off, he met with Swale's "Apollonius," in which is given a geometrical construction "of the description of a polygon in a given circle, each of whose sides shall pass through a given point;" and some modifications of the preliminary propositions and the constructions have been extracted by Mr. Gaskin, to form his "third Appendix." We doubt, however, whether most readers will not give the preference to the original form; and as to the construction to be derived for *any polygon* and any conic section, we believe that those geometers who have paid most attention to the problem are convinced of the hopelessness of equalling that of Poncelet, which is effected by the *ruler only.*

Mr. Gaskin has also sent us some generalisations of Swale's construction, where the conic sections are substituted for the circle. A personal friend of ours, who has paid great attention to the *history* of the problem, and who has been some time preparing a paper on the subject for press, had some time ago made a similar extension of Swale's method. We felt, therefore, in a dilemma as to printing Mr. Gaskin's; but upon consulting our friend, he not only did not object, but with the utmost frankness urged its appearance, waiving all claims to priority, and resigning the subject to Mr. Gaskin's investigation. This we think the more liberal, as we know our friend was in possession of the extension long before Mr.

Gaskin had ever seen or heard of Swale's "Apollonius." We hope to print it soon, when our readers will be able to judge for themselves; but meanwhile, we venture to say, that it betokens Mr. Gaskin to possess geometrical power nearly akin to his symbolical; whilst at the same time it bespeaks much less of practical dexterity in the use of the one method than in the other. Time and perseverance will completely remove the disparity in this respect; and we shall hope to see that due admixture of the Cartesian and the ancient geometry displayed in his future writings, which bespeaks the perfectly-poised geometrical mind.

We may notice likewise another instance of the unfortunate effect of want of attention to the study of other than University works by Mr. Gaskin. At p. 245, he gives an investigation of Pascal's theorem (the celebrated mystic *hexagram*,) which brought very forcibly back to our minds, a solution which had been given a few years previously in the *Lady's and Gentleman's Diary*, for 1843, (p. 71.) If, indeed, there be any difference between the two, it is in favour of the Diary solution—a decided proof, at any rate, that Mr. Gaskin is not a copyist. The *principle* is essentially the same in both, and the details differ in no important particular; the Diary solution is confessedly taken from Magnus of Berlin—an author to whom more than one English geometer is indebted to a greater extent than has been avowed with that clearness which strict candour would require. We are, we confess, somewhat perplexed to account for this coincidence; since it requires the employment of Lagrange's method of *conditional multipliers* (very generally, but very absurdly, called "arbitrary multipliers,") which Mr. Gaskin has used so sparingly throughout his work, that we almost fancied he must have had some special objection to the principle itself. We, indeed, grant that the principle is laid down in a very slovenly, and often erroneous, manner—we even grant that no good philosophical explication of it has ever fallen under our notice:—yet it would have been a subject admirably adapted to Mr. Gaskin's talents to have developed and applied the principle; and the present work furnished a fitting occasion for it. In a second edition, we have no doubt that this point will receive proper attention from him.

This mention of Pascal leads us to revert to a former remark of ours, relative to the halting step of the Cartesian geometry in its progress through an investigation of any especial difficulty. In this supplement (the second) we see that a few of the cardinal properties are deduced by coordinate considerations (all of which might have been, and have often been, obtained by pure geometry with equal brevity and greater elegance—as for instance Pascal's theorem in the Diary referred to;) and *then* recourse is had to *geometrical deductions* of the consequences! This species of legerdemain we hold to be both unscientific and mischievous: the product is "neither flesh nor fish," as our Catholic ancestors used to say. But we desist from further remark just now; and that under a confident belief that this "hotch-potch" method of investigation is approaching its death-struggle.

We have taken our exceptions to Mr. Gaskin's book in no captious spirit, but with perfect freedom and in perfect sincerity; we hope, too, without giving the least personal offence or personal pain to its distinguished author. We respect both his character and talents too highly to give either offence or pain intentionally: but on public questions of science and education, we hold ourselves at perfect liberty to discuss the character and tendencies of any work which comes before us; and that without considering who may be its author, except as far as the author's position is one which facilitates the diffusion of truth, or the propagation of error. We have differed from Mr. Gaskin with regret: but we *do differ on first principles;* and we cannot but feel sorry that he has not done *himself* the justice that was almost forced upon him by the undertaking in which he was engaged.

We are still more sorry to see this

work making its appearance *at the present juncture*. The papers on which he has founded his solutions are, professedly, the *geometrical* papers of St. John's—some of them, though not very many, are strictly geometrical: and the greater part can be solved by means of transversals and other *geometrical* methods. Why, then, should Mr. Gaskin have gone out of his way to apply the Cartesian method to them all? Often, too, at the expense of much labour, and obtaining a solution far inferior to the geometrical one after all! He displays great mastery over his instrument, it is true; but we must, notwithstanding, be allowed to question the soundness of that judgment which attempts to efface all traces of the ancient geometry from the Cambridge papers. He tells us, too, in the preface to his former work, that "in every case he has endeavoured to point out the form in which the student would be expected to present the solution to the Examiner;" and, of course, the present one is constructed on the same plan, and with the same objects. He, therefore, virtually tells the undergraduates that they are "expected" to *solve every geometrical problem by means of coordinates!* Now, in connection with this, we must remember that Mr. Gaskin is one of the Moderators for the coming examination; and that, on that occasion the "Graces" of May, 1846, which enforce something more of attention to geometry than heretofore, come into operation. Mr. Gaskin has, consequently, put himself in an unfortunate position by the publication of this book, whilst he is appointed to officiate as Moderator on so critical an occasion. We have that confidence in his high sense of honour, that we do not for a moment suppose he will betray the trust reposed in him, by accepting, as solutions of purely geometrical problems, any of the attempts that may be made to palm upon him, solutions constructed on the principle of his own work. His false position, then, is this:—That he has issued a series of model-solutions of geometrical "problems" which the men will naturally accept as an exposition of the views of their Moderator; whilst he is in strict honour bound to admit nothing of the kind, and to insist upon totally different methods of solution. Being thus pledged on both sides of the same question, his dilemma is anything but an agreeable one: but we trust the great interests of the University and of accurate science, will be considered by him as paramount to any implied liability to the contrary, which he may suppose he has incurred towards the purchasers of his work. We have the fullest reliance upon him ourselves.

In conclusion, we wish Mr. Gaskin safely through the opening month of the year, untouched in his honour, and unscathed in his feelings. We shall watch his progress with anxiety, and shall gladly congratulate him on the successful achievement of his arduous and difficult task. We shall gladly welcome him back to the labours of science; although we could wish them to be bestowed upon subjects more worthy of himself and of his reputation than writing model-solutions of mere college problems.

CAUSES OF THE FRACTURE OF AXLES.

Dear Sir,—A letter in the *Times* of Saturday last, giving an account of the breaking of an axle on the Lancashire and Yorkshire Railway on the previous Tuesday, has reminded me that I threatened to inflict some remarks upon your readers on the fracture of railway axles, provided you thought my letter on buffers worthy of insertion, (which I am happy to say you did.)

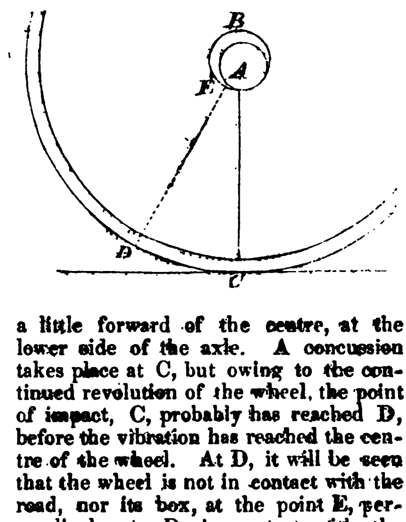
The continuance of the evil, although not recently attended with fatal consequences, shows the necessity of continued attention to the subject.

I am disposed to think well of Mr. Bessemer's improved axle (see *Mech. Mag.*, May 29, 1847,) but not exactly for the same reason as that which he advances as the chief argument in its favour, viz., that it will prevent *crystallization* of the iron by the *torsion* to which railway axles are subjected. Although torsion, doubtless, does occur to some extent, yet I believe that it is never sufficient to cause the fracture of such axles; because there is not enough

friction between the wheel and the rail to produce the torsion of the axle beyond the point of elasticity. I think also that Mr. Bessemer has too hastily concluded that crystallization results from torsion. My own observations lead to quite a contrary conclusion. The effect of torsion on any fibrous substance is to produce separation of the fibres longitudinally—to destroy their lateral cohesion—as will be readily seen by "the twisting of a wire, or the bending a stick backwards and forwards," as Mr. Bessemer suggests. That which was a stick or a wire, by continued twisting in alternate directions, becomes a bundle of fibres, having little or no lateral cohesion. As long as these fibres are not twisted far enough in either direction to draw the particles of the substance beyond the distance within which they mutually attract each other, so long do the fibres retain their tenacity, notwithstanding their separation; but when that distance is passed, the outermost fibres (which have the greatest strain, being farther from the axis of motion) separate one by one, and the whole mass is ultimately torn asunder. In this process there certainly is nothing that tends to produce crystallization; and in the case in point there is the less probability of the particles being drawn beyond the limits of mutual attraction—in other words, beyond the point of elasticity—because the axle is not subjected to any considerable amount of tension as well as to torsion, but rather the contrary. If, therefore, it is improbable that the excessive torsion of the axle takes place, and if it be nearly, if not quite, certain that torsion does not produce crystallization, we may fairly conclude that torsion is not the chief cause of fracture. If it were so, the separated parts would appear fibrous, or as if torn asunder, and not crystalline, which I believe they invariably are.

It appears to me that the chief, if not the only, cause of fracture is *uninterrupted vibration*. Mr. Bessemer shows by a calculation that the axles of an omnibus are apparently subjected to a much larger amount of vibration than those of a railway carriage; why, then, if vibration be the cause of fracture do not the former more frequently break? First, because the wheels being higher and more elastic absorb a large portion of the vibration. Second, because the wheels move freely on each end of the axle, and the bearings are *inside* of the wheels. When, therefore, the vibration reaches the axle, it has been diminished by its passage through the wood of which the wheel is made, and it is free to flow out at each end of the axle uninterruptedly. Besides this, I am not quite sure that the vibration caused by the concussions of an omnibus wheel on the stones ever reaches the axle at all, because of the continuous revolution of the wheel.

The following diagram will illustrate my meaning: the two inner circles, excentric to each other, show the nature of the contact between an axle and its box (which being fixed to the wheel must be considered as a part of the wheel.) A, is the axle; B, the box. They are in contact, when in motion, only at a point



a little forward of the centre, at the lower side of the axle. A concussion takes place at C, but owing to the continued revolution of the wheel, the point of impact, C, probably has reached D, before the vibration has reached the centre of the wheel. At D, it will be seen that the wheel is not in contact with the road, nor its box, at the point E, perpendicular to D, in contact with the axle; the wheel, therefore, may vibrate without affecting the axle at all. If it should be objected to this, that the box fits too closely to the axle, it may be replied that, strictly speaking, they are not in actual contact anywhere, particles of oil, or some other lubricating substance being interposed between them; which as they *certainly* keep the particles of iron beyond the point of mutual attraction, may also prevent the trans-

mission of vibration from the box of the axle. The nave of the wheel, too, with its grain at right angles to that of the spokes, serves as a cushion to deaden the jars which they communicate. All those things are in favour of the omnibus axle, besides others which might be mentioned; such as the lower rate of velocity, and the absence of any centrifugal motion in the particles of the iron, owing to the circumstance of the axle being fixed, and not revolving like those of a railway carriage.

The immediate cause of the crystallization of railway axles is, undoubtedly, the wheel being so firmly keyed to the axles that they may be considered as one mass. All the vibrations which the wheels receive they faithfully transmit to the axles; the wheels are of too small diameter and too rigid. The greater part of the vibration which the axle receives is thrown towards the centre, because the outside bearings prevent its transmission outwardly; before the wave of vibration which the axle receives has expended its force, it is met by another wave coming from the other side; the particles of iron repel each other at the point where these opposing forces meet, and dispose themselves at right angles to the general mass of the axle; these distributed particles prevent the transmission of subsequent vibrations; other particles assume similar positions, varying according to the amount of force transmitted to them and the attraction of surrounding particles; and thus gradually the whole mass becomes irregularly crystallized.

When a piece of iron is broken asunder, by repeated blows of a hammer, *all one way*, it is found that the fracture appears half crystalline and half fibrous, the latter being on the upper side which received the blow, the former next the anvil or vice; the upper side being convex has been stretched, as it were, in the process, and the fibres consequently torn asunder—the under side has been compressed, and the *return* vibration from the anvil has polarized the molecules, giving them a new arrangement transversely to their former one.

Something analogous to this takes place with respect to a railway axle, the whole weight of the body of the carriage being supported at the extremities of the axle outside of the wheels; that part of it between the wheels, which happens to be uppermost, is to a certain degree in a state of tension, and the lower side in a state of compression, which is increased by the lateral concussions of the wheels against the rails. At a lower rate of speed it is probable that the vibration may not reach the middle of the axle, but at a high velocity, no doubt the blow given is sufficient to send it to the opposite end if it were unopposed. It is the outlet given by Mr. Bessemer's arrangement, for the vibration of each half of the axle to expend itself without affecting the other half, which induces me to think well of it, provided it be so made that the ends within the coupling-box be not in actual contact, and that some non-vibrating substance (as leather) be placed between the coupling-box and the axles; but I object to the concentric rings sunk in the axles, because they would diminish their capacity for the transmission of the vibrations, and the ends would in consequence be liable to jar off, as the screwed ends of bolts frequently do.

Another plan would be to make the axle of one wheel hollow, and that of the other wheel solid, placing the one within the other through nearly its whole length. They need not be in contact except at the ends, so that each vibration would have nearly the whole length of the axle to travel; but even in this case the same precautions as I have suggested above would be necessary to prevent communication of the vibrations from one axle to another.

I have not mentioned all the injurious influences to which the railway axle is subject, but as I think I have inflicted enough of my tediousness upon your readers for the present, I will only ask pardon if I have stated too dogmatically what may be in some measure only hypothetical, and subscribe myself,

Yours, very respectfully,
JAMES ROCK, Jun.

P. S.—Since writing the above I have received your last Number, wherein I perceive that an axle similar to that which I have suggested above has been patented. You will remember that I mentioned the plan to you in August last.

Hastings, December 15, 1847.

ON THE LAW OF CONNECTION OF BERNOULLI'S NUMBERS.

BY PROFESSOR YOUNG OF BELFAST.

(Concluded from page 575.)

If, as is usual, we represent the numbers of Bernoulli, with their proper signs, by

$$1, B_1, B_2, B_3, B_4, \&c.,$$

then the foregoing development will be thus expressed:

$$\frac{x}{e^x-1} = 1 + B_1 x + B_2 \frac{x^2}{2} + B_4 \frac{x^4}{2.3.4} + \&c.$$

And if the object be merely to deduce these numbers, or to determine the law which connects them together, independently of the numerical divisors of the powers of x, then it will be necessary to assume this independence in the conditional coefficients (page 574). We may thus write the identity at page 574, of which the first member is x, as follows:

$$x = (x + \frac{x^2}{1.2} + \frac{x^3}{1.2.3} + \frac{x^4}{1.2.3.4} + \frac{x^5}{1.2.3.4.5} + \&c.) \times$$

$$(1 + 2B_1 \frac{x}{1.2} + 3B_2 \frac{x^2}{1.2.3} + 4B_3 \frac{x^3}{1.2.3.4} + 5B_4 \frac{x^4}{1.2.3.4.5} + \&c.)$$

From which we deduce, as already explained, the following conditions: viz.

$$2\,B_1 + 1 = 0$$
$$3\,B_2 + 3B_1 + 1 = 0$$
$$4\,B_3 + 6B_2 + 4B_1 + 1 = 0$$
$$5\,B_4 + 10B_3 + 10B_2 + 5B_1 + 1 = 0$$
$$6\,B_5 + 15B_4 + 20B_3 + 15B_2 + 6B_1 + 1 = 0$$
$$\&c. \qquad \&c. \qquad \&c.;$$

in which expressions, when taken in reverse order, we recognise the law of the binomial coefficients, the final coefficient, in each case, being absent. If therefore in the development of $(1+B)^n$, we remember to write the several exponents of B, as they arise, *below*, instead of *above* that symbol, we may express the general law, under which the preceding particular cases come, by the following form: viz.

$$(1+B)^n - B_n = 0$$

which, as n is necessarily a whole number, may always be expeditiously developed by deducing the several coefficients one after another in the usual way, all of them being integral.

Although for the purpose of carrying on this successive derivation of the coefficients one after another, it is proper that they be written down in order, without any omissions, yet it is of importance to notice that every B with an odd index, except the first one, B_1, will vanish; that is, every such B, to satisfy the above law, must be zero; so that though, for the sake of the coefficient, a B with an odd index be written down in its proper place in the development, no time is to be spent in computing its value: that every such B is zero is easily shown thus:—

Whatever be the development of the proposed function (p. 574), it is plain that if we write under it what the development becomes when x is negative, and subtract, the even powers of x will disappear from the remainder, but all the odd powers will be retained. Now,

$$\frac{x}{e^x-1} - \frac{-x}{e^{-x}-1} = \frac{x}{e^x-1} + \frac{x}{\frac{1}{e^x}-1} = \frac{x}{e^x-1} - \frac{xe^x}{e^x-1} = \frac{x(1-e^x)}{e^x-1} = -x,$$

so that the only odd power of x involved in the remainder is $-x$; which authorises the exception above provided for. And this is the usual way of proving the absence of all the higher odd powers of x, and consequently, that every B with an odd index, B_1 alone excepted, must be zero.

HINTS ON VENTILATION.

Sir,—An important step has been at length achieved in the appointment of a commission to supersede the numerous trusts whose care was to look to the sewerage of the metropolis. Whether this step has been brought about solely by the great and unceasing cry that has gone forth for sanatary reform, or has been urged upon the authorities by the apprehension of the approaching cholera is of little consequence. I fear however that the non-interference with the city authorities, whose privileges are not, in this case, to be interfered with, will cause considerable hinderance in the effective working of the new commission.

A Sanatory Bill, such as we hoped ere long to see passed, must legislate on a great variety of subjects in order to exterminate the nuisances that have been suffered to exist in our towns, filling our hospitals with sick, and the burial-grounds with those who, but for the vile atmosphere in which they lived and died, might still have continued useful members of society.

Amongst the subjects to be embraced by an effective sanatory measure may be enumerated—ventilation, public and private; improved sewrage and drainage; increased supply of water; abolition of intermural burials; paving, lighting, and scavengering; baths, washhouses, &c., &c.

Theory has done much for the subject of ventilation—practice but little. Much has been said and written on the subject; but those who visit our crowded churches, theatres, and other places of general resort, are still compelled to breathe a vitiated atmosphere wholly unfit for respiration.

A healthy adult requires a certain quantity of air for respiration per minute; one hundred persons collected in a room together, require one hundred times as much, which multiplied by 60 and divided by the capacity of the room, gives the number of times the room should be filled by fresh air in an hour, and this again compared with the areas of the apertures that admit the air will give the velocity of the current of fresh air flowing into the room. All this is very simple. It is equally easy by artificial means to produce this current, and it no doubt is produced; yet in the middle of the room the crowd still pants for fresh air, and if we were to test the air which is flowing out of the room, we should find it scarcely more vitiated than that which the people are inhaling within it. It is not only necessary that a sufficient quantity of air be admitted into the room, but that it should also be diffused throughout, which can only be effected by abstracting the foul air opposite to the part where the fresh air is admitted, and then causing a gentle current direct through the room. Now this is a thing which I fear hardly any known system of ventilation can be said to accomplish effectually.

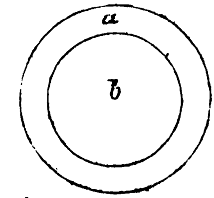
The vital portion of the air we breathe is as necessary for the support of combustion as of life. Flame can no more be produced without a due supply of oxygen than life can be supported under similar circumstances. We may reasonably suppose that the same operation, though in a less violent degree, goes forward in the lungs that is perceptible in the furnace. At least the products evolved are the same, the oxygen mixing with carbon producing carbonic acid gases, and with hydrogen forming water; and these noxious gases, with nitrogen in a free state, are given off both from the lungs and from a well-regulated furnace.

Since, then, there is such similarity between the vital principles of flame and life, it is but reasonable to suppose that that principle which is found to afford the greatest brilliancy of the former, will be best adapted to the ventilation of rooms for the preservation of the latter.

Observe the flame of a candle. It consists of a thin film of white hot vapour, which constitutes the light evolved by the candle; this light is superficial only, for it encloses an interior portion of unconsumed carbon which cannot burn for want of oxygen. If by means of a blow-pipe air be admitted to this interior portion the light is greatly increased. The construction of the flame aptly represents the conditions of a crowd met together in the open air, though the great heat of the candle would exhibit the evil more glaringly than is felt by the crowd. The exterior of the flame alone gives out light; the interior part for want of oxygen is incapable of emitting it; animal life could not exist in such an atmosphere; and so it is with a crowd, though in a less degree. The individuals composing the

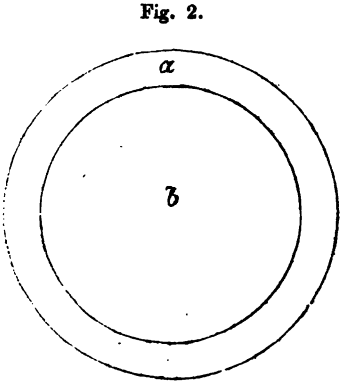
exterior ring of the assembly are well supplied with fresh air, but those towards the denser parts will have a vitiated atmosphere to breath, consequent upon its having to pass through and mingle with the impure gases arising from the outer members of the crowd. Thus, let fig. 1

Fig. 1.



represent a horizontal section of the flame of a candle; *a*, the luminous ring, and *b*, the dark interior. So, similarly, fig. 2, would represent the state of the

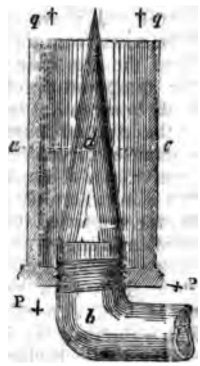
Fig. 2.



atmosphere breathed by a crowd; *a*, being the comparatively pure exterior; *b*, the exceedingly impure gas in the interior.

Let us pursue this inquiry further; but instead of the open flame of a candle, let fig. 3, represent a gas lamp; *b*, a pipe, conveying the gas; *d*, the flame; and *a*, *c*, the chimney-glass enclosing the flame. First, let the diameter of the flame be the same as the pipe, and let the only supply of air to support combustion come in the direction of the arrows, *p p*, or down the chimney-glass, *q q*, (if indeed it could be admitted this latter way). This state of things will not inaptly represent a room crowded with people and ventilated round the sides. For the

Fig. 3.



chimney-glass represents the walls of the room, and the flame the people. If we take any section of the flame through *a*, *d*, *c*, it will present the appearance of fig. 1, and similar remarks are applicable to it. The centre of the flame is dark. And the air in a similarly ventilated room would be unfit for respiration in its crowded centre.

Again; some plans of ventilation admit the air at the level of the ceiling, and abstract through the ceiling. Let us see the effect of this. By stopping up the aperture (*pp*) the gas would pass through the chimney glass unconsumed, and not take fire until it arrived at the top, thus making the chimney glass merely as an enlargement of the pipe to convey the gas.

The Argand burner produces a more brilliant light by confining the flame to within proper limits; and this principle, so effective in producing light, I would consider the best for ventilation.

It may be objected, that the above illustrations are not analogous, inasmuch as the temperature of a flame greatly exceeds that of a room under any circumstances; and, secondly, because I arrive at conclusions without sufficient reason.

To the first of these objections I would reply,—That their illustration exhibits a very exaggerated view of an ill-ventilated apartment; for life could not be supported under such circumstances if they did not. And, secondly,—Any reasoning on the points would greatly exceed the intended limit of this communication, which is written with a running

pen, and without any intention of entering into chemical or mathematical details.

I have remarked, above that the foul air should be taken from the room opposite to where the fresh air is admitted; and as the temperature of the room causes the air to ascend, it appears to me that, like the Argand burner, the air should be admitted through the floor, and pass off when vitiated through the ceiling. A maltster's kiln exemplifies this, and is, perhaps, better ventilated than any other description of structure. A maltster dries his malt more by the application of air passing through it than by the direct application of fire. To effect this, the floor on which the malt is laid consists of perforated tiles, through which the heated air ascends, and, passing through the malt, escapes by means of a cowl in the roof. The perforated tiles forming the floor admit the air to every part of the room, and a constant current under complete regulation is passing through the room and out of the roof. Now, Sir, it would be a very easy matter, and much add to the appearance of our places of public resort, if ornamented porcelain tiles were used for flooring, perforated with holes through which the attempered air might pass, diffusing itself to every part of the house, and when vitiated, escaping through the ceiling.

At some future opportunity I may be tempted to enlarge on this point, but at present I have exceeded my intended limits, and must conclude.

I am, Sir, yours, &c.,

WILLIAM DREDGE.

10, Norfolk-street, Strand, Dec. 16, 1847.

ON THE EMPLOYMENT OF HEAT AS A MOTIVE POWER. A WORD OR TWO IN CONCLUSION BY x^2.

Sir,—I have no objection to make to the Atomic Theory; "A. H.'s" explanation of it I perfectly agree with; and neither did I, nor did I intend to "bring forwatd specific gravity as an objection to it." This theory refers, as your correspondent himself implies, to chemical phenomena only; and these chemical atoms may consist of smaller atoms, as he admits. This is all I require, for it may be precisely with reference to these smaller atoms that the question of heat is to be considered. The atomic theory has never been applied beyond its legitimate limits. Dalton, indeed, attempted to apply it to determine the specific heat of elastic fluids, upon the hypothesis that under equal pressures and temperatures their ultimate particles contained the same quantity of heat. The result of his calculations was of course utterly erroneous; as we have seen that although it may be applied correctly to solids and fluids it fails in the case of gases. Besides, I say that if it could have been taken for granted that heat might be considered as acting chemically and as a substance, it would have followed at once as a truism, and without either experiment or mathematical investigation, that the specific heats of equal weights were inversely as the atomic weights; and that in fact it is mere tautology to say so, when we have once asserted that the comparative number of atoms of two substances may be considered the same as if heat were a chemical agent.

As to the second point, I accept "A. H.'s" admission, that "if the gaseous particles repelled each other and could produce expansion without requiring any heat, then the corrections proposed would be necessary." The gaseous particles *do so*; "they *have* a repulsive influence on each other *independent of the heat communicated.*" Not, indeed, according to the law I assumed; that was a mere assumption (and I might have made any other) adopted for conveniece, and because it spared us all consideration about heat. I am not likely to forget that Boyle's law implies a constant temperature, as "A. H." will see by referring to p. 13 of your last Volume.

The real law, however, is $\frac{P^1}{P} = \left(\frac{a}{x}\right)$

where P and P′ are the pressures at the heights a and x respectively. For common air K = 1.416. The work done, therefore, without the assistance of additional heat by a column of air of a height, a, and of such density that it exerts a pressure, P, will be, as it expands to a height, b,

$$\int_x^a {}_b \, P\left(\frac{a}{x}\right)^{1.416},$$

aad when P is constant, and heat is added, the work done is P.$(b-a)$. The difference of the two, therefore, is *the work due to the heat alone.*

And now, Sir, I shall not trouble you, or "A. H.," with another word on the subject, as if ever we are to understand each other. we must do so now. Indeed I should have carefully abstained from saying anything, but that I imagined what called forth my remarks to be oversights, which merely required pointing out to be corrected, and as obviously erroneous as that noticed by "A. H." himself in his note at page 450. However, I was wrong, and I suppose we must agree to differ.

I am, Sir, yours, &c.

x^2

SANATARY MEASURES—MR. ELLERMAN'S ANTIDOTE.

The Marylebone Vestry having appointed a Committee "to investigate the properties of the several compounds now before the public as disinfectants or deodorisers," the Committee have made a report of their labours, from which we make the following extract:

"There are four compounds chiefly employed or recommended for the purposes in question, namely, chloride of lime; Sir William Burnett's liquid, or chloride of zinc; Ledoyen's, which is nitrate of lead; and Mr. Ellerman's, consisting of a preparation of iron.

"Chloride of lime has for many years been in use for destroying offensive odours, and is by some authorities considered a disinfectant. It has this disadvantage: that, in removing one odour, it imparts another, which, although not deleterious, is by no means agreeable.

"Chloride of zinc was introduced some years ago by Sir William Burnett, as an agent, for preserving woods, ropes, sailcloth, &c., from decay. It had recently been recommended for destroying offensive odours, and preventing contagion. The former of these properties it possesses, but in a less degree than chloride of lime; and further evidence is required to establish its claim to the character of a disinfectant.

"Ledoyen's fluid, which is a solution of nitrate of lead, has a specific action on noxious matters containing sulphuretted hydrogen and sulphuret of ammonium, which are the prevailing results of the decomposition of animal and vegetable matter. It has been used with success for depriving night soil of its offensive effluvia, and is useful in hospitals, as a means of neutralising the odour of fecal matter. It has been recommended for preventing contagion; but the evidence on this subject is not considered by the best authorities to be conclusive.

"Mr. Ellerman's fluid is also efficacious as a means of destroying the odour of night soil, and other similar substances. It possesses also this advantage, that while it neutralizes the odour so as to admit of the soil being removed at any time without creating a nuisance, it does not in any degree interfere with the efficacy of such matters as manures. On the contrary, it rather tends to increase their fertilizing quality. It is also the least expensive of the four compounds above alluded to.

"In an experiment performed by your Committee with night soil, it was found that Mr. Ellerman's fluid possessed a greater power than any of the others in destroying the smell, leaving merely a slight acid odour. Next in order, the chloride of lime was found to be efficacious, but the smell of the chloride was powerful, and continued for a considerable time. Sir W. Burnett's was less efficacious than the former fluid; and the nitrate of lead, although producing some effect, was less powerful than the others, a large quantity being required to produce the desired result."

Mr. Ellerman's patent not having been yet specified, the particular nature of his "preparation of lead" still remains a secret.

ABSTRACTS OF SPECIFICATIONS OF RECENT ENGLISH PATENTS.

WILLIAM VICKERS, OF SHEFFIELD, STEEL-MANUFACTURER, *for improvements in the manufacture of iron.* Patent dated June 19, 1847. Specification enrolled December 12, 1847.

The improvements which form the subject of this patent consist in melting pig iron with iron turnings, or scrap iron, and in running the melted mixture, when divided into fine streams, into cold water; after which it is converted by the usual process into malleable or wrought iron.

The mode of carrying out the invention preferred by the patentee, is as follows:—When it is desired to produce wrought iron of an ordinary quality, 30 per cent. of iron turnings, or scrap iron, and 70 per cent. of pig iron, are melted in a cupola furnace, and then run into an iron tray, which is perforated with numerous holes of about half an inch in diameter, and coated on the inside to the depth of half an inch, with a composition of sand, similar to that employed for stopping the outgate of the furnace. This layer of sand is also perforated with holes of a quarter of an inch in diameter. The tray is placed about fifteen feet above a wooden tank, which is four feet in depth, and filled with water. The melted mixture, after it has been run into the tray, passes through the holes before mentioned, whereby it is divided into streams, and falls into the cistern or tank of cold water. When the iron is intended to be converted into steel, the patentee proposes to increase the proportion of iron turnings or scrap iron to 45 per cent.: he also states, that he has employed with advantage from three to five per cent. of black oxide of manganese, which he places in the tuyere holes, and, by means of the blast, introduces it into melting metal.

JOHN HORSLEY, OF RYDE, *for improvements in preserving animal and Vegetable substances.* Patent dated May 6, 1847. Specification enrolled November 6, 1847.

Mr. Horsley makes use of a preservative liquor thus prepared:—"I first perfectly neutralize strong acetic acid (I prefer that known as Beaufoy's concentrated acetic or pyroligneous acid) with the salt called sesqui carbonate of ammonia, the result being the formation of an acetate of ammonia, which is eminently volatile, and is given off in the act of cooking. I then dissolve in such quantities as may be thought necessary, say eight, nine, or more imperial pints of water, which has been well boiled, to free it from air and other impurities, and filtered through animal charcoal, a small quantity, say from six to twelve ounces of chloride of sodium (common salt.) To this solution I add two imperial pints of the neutral acetate before mentioned, though I do not confine myself to any of these particular quantities, a little flavouring of spice being added if required."

The patentee applies this liquid in two ways:—"In the preservation of meat, fish,

&c., for the purposes of food, I have two methods of procedure; either by simple immersion of the same in a certain liquid hereafter mentioned, or injecting the same, and then packing articles so prepared between layers of charcoal, or any other equally sweet and absorbable material, not liable to fermentation, in a suitable air-tight vessel, the charcoal being also saturated with the liquid. When it is required to keep longer than fourteen days, I prefer the latter method.

"Meat thus treated is either put up into vessels, and covered with the liquor, or it may be wrapped up in the linen or any other fibrous material, saturated with the liquid, and placed between layers of sifted charcoal, or any other equally sweet and absorbable material, in such vessels as may be found to conduce to the safe keeping of the meat, as well as resist the action of the fluid or gaseous matter theirein contained."

What the patentee claims is—"The use of ammonia in such a combination with acetic or purified pyroligneous acid as shall not interfere with the principle of decomposition or volatillization of their elements upon the application of heat, or in the act cooking."

Azulay and Solomon's Patent Fuel.

We have received a letter from Mr. Azulay, calling upon us, "as an act of common justice," to give "chapter and verse" for our assertion "that there is nothing new in his mode of manufacturing artificial fuel." "I have never," he says, "before heard it proposed to reduce charcoal, &c., to powder *before compressing*." We readily respond to Mr. Azulay's call. In the specification of a patent granted to Mr. M. J. Cooke, March 2, 1843, he directs coal, coke, or charcoal to be first ground to a fine powder, then mixed with other ground materials, and finally subjected to as high a pressure as is requisite "to render the mixture perfectly solid." And, subsequently to Cooke's patent, there have been several others, which consist chiefly of improved modes of effecting the grinding and compression. We need only refer to those of Wylam, April 7, 1845; and Bertram, May 26, 1846. The Wylam fuel was that to which we particularly referred as being all that could be desired. It is now, we believe, more extensively used than any other.

WEEKLY LIST OF NEW ENGLISH PATENTS.

William Westbrooke Squires, of Paris, M.D., for a mode or modes of producing a vacuum, which mode or modes may be applied to pneumatic, hydraulic, and hydrostatic apparatus, and to machinery for obtaining motive power. December 18; six months.

Richard Wrighton, of Lower Brook-street, Grosvenor-square, Middlesex, gent., for improvements in apparatus to be applied for railway carriages and engines. Dec. 22; six months.

Charles André Felix Rochaz, of Paris, merchant, for certain improvements in treating zinc ores, and in manufacturing oxide of zinc. Dec. 22; six months.

Henry S. Baker, of Boston, in the United States, of America, for a certain new and useful improvement in steam-boiler furnaces. Dec. 22; six months.

Richard Baird, of Dundee, Scotland, engineer, for a new or an improved method of communication between the guards, engine drivers, and other servants in charge of trains of carriages and wagons on railways, and also between the passengers and engine drivers and other servants in charge of such trains. Dec. 22; six months.

Robert Stamp, of Chelsea, hatter, for improvements in the manufacture of fabrics to be used for covering hats, caps, and bonnets, which fabrics may be used for other articles of wearing-apparel. Dec. 22; six months.

Charles William Siemens, of Manchester, engineer, for improvements in engines to be worked by steam and other fluids. Dec. 22; six months.

WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

Date of Registration.	No. in the Register.	Proprietors' Names.	Addresses.	Subjects of Designs.
Dec. 17	1296	Thomas Robert Hill	Church-street, Soho	Travellers' door-fastener.
"	1297	Edward John Payne	Chancery-lane	Flanged roller for rolling metals.
18	1298	Samuel Siddall...........	Dronfield, Derbyshire	Reaping-hook.
20	1299	William Bridges Adams.	Fair Field Works, Bow	Axle-guard for railway carriages.
21	1300	John Spurgin, M.D......	Guilford-street, Russell-square, London	Hall shoe-scraper and brusher.
23	1301	Robert and William Hawthorn	Newcastle-upon-Tyne	Parts of locomotive engines with cranked axles.
	1302	Joseph Dixon	Manchester	Universal mute drum.

Advertisements.

Erratum.—In our weekly List of Patents, No. 1249, the following was omitted:—"John Harvey Sadler, of Holbeck, Leeds, Scotch iron merchant, for improvements in constructing bridges, aqueducts, and similar structures. Sealed July 7, 1847."

CONTENTS OF THIS NUMBER.

NOTICES TO CORRESPONDENTS.

± *In our next.*

We have already informed "J. W." that his problem cannot be inserted.

Communications received from Mr. Wheeler—M. N. C.—Mr. Clive—Mr. Ballingall.

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END OF VOLUME XLVII.